— Uphoff

Northern Illinois College of Optometry

Optometry III

(Special Subjects)

Study Outlines

Hyperopia
Tinted lens
Fusion
Eyesymptoms

CONTENTS

CHAPTER I

ACCOMMODATION, CONVERGENCE, AND THEIR RELATIONSHIP.

I. INTRODUCTION.

A. Accommodation and convergence are reflex actions.

B. The action of accommodation is not noticeable with the naked eye while convergence is.

C. In accommodation we are concerned with an intrinsic muscle, while in convergence, with a pair of extrinsic muscles.

D. Accommodation and convergence are two necessary functions of the eye to procure and maintain good and comfortable single binocular vision.

II. DEFINITION OF ACCOMMODATION.

The ability of the eye to change its dioptric power to bring rays of light from any distance upon the retina but at different times.

III. POSSIBILITIES OF ACCOMMODATION.

A. Just what part of the anatomy of the eye was responsible for this phenomenon was disputed for a long time and several assumptions were made.

1. The lens in viewing near objects moves forward.

2. Accommodation is brought about by constriction of the pupil.

3. Accommodation is brought about by elongation of the eyeball.

4. Accommodation is caused by an increase in the curvature of the cornea.

B. Today we have definite proof that the change of curvature of the crystalline lens produces accommodation.

C. At present -- we have two main theories.

1. Helmholtz's Theory.
2. Tscherning's Theory.

IV. AMPLITUDE OF ACCOMMODATION.

A. The term amplitude of accommodation includes two factors:
The P.R. and P.P. of Accommodation.

1. Definition of P.R. of Acccmmodation: A point in conjugation with the fovea when the eye is static.

2. How to determine the P.R. of Accommodation.

a. In Emmetropia.
b. In Hyperopia.
c. In Myopia.

3. Definition of P.P. of Accommodation: A point in conjugation with the fovea when the eye is accommodating to its utmost.

4. How to determine the P.P. of Accommodation.

a. By test-type or test-letters for near vision.
b. By dynamic skiametry.
c. By Scheiner's test.

B. The amplitude of accommodation is the full amount of accommodation of which the eye is capable, and is therefore the algebraic difference between the near point and far point of accommodation expressed in diopters.

C. The amplitude of accommodation can be obtained in several ways:

1. Most common method:
   Correct the ametropia, then find the nearest point at which maximum distinctness of vision is possible and convert into diopters.

2. Another method:
   Consists of fixing the eyes upon a reading type set at 13" and adjusting the focus at that distance with +3D spheres, then building minus spheres before the eyes until the strongest is found with which vision can be maintained. The power of the latter measures the amplitude of accommodation.

D. The amplitude of accommodation is of considerable importance.

1. A decrease of amplitude may mean the approach or presence of presbyopia.

2. An absence of amplitude may mean paralysis of the ciliary muscle or Aphakia.

E. The amplitude varies with age.

F. Range of accommodation.

V. SPEED OF ACCOMMODATION.

A. A great and important factor in any moving facility of modern invention.

B. Exercises for sluggish accommodation.

C. The quality of accommodation is as important as the quantity.

VI. EQUALITY OF ACCOMMODATION IN THE TWO EYES.

A. Only when the object is on the median line.

B. If the object is toward the side then the distance between the object and each of the eyes is altered.

C. A change in distance means a change in accommodation.

VII. BINOCULAR VISION.

A. The fact that we see with both eyes is expressed by the term "Binocular Vision."

B. If we see two distinct objects where there is actually only one, we have a case of "Diplopia."

C. If we see one object in spite of the two images that the eyes receive we have "Single Binocular Vision."

D. This is accomplished by the factor of fusion faculty.

VIII. CONVERGENCE.

A. Definition:

The term convergence is defined as the associated movement of the two eyes either both toward the nose or both away from it along the horizontal plane.

B. Amplitude of Convergence.

1. The term Amplitude of Convergence includes two factors: the P.R. and P.P. of convergence.

2. Definition of P.R. of convergence:

It is the point to which the visual lines are directed, when convergence is at rest, or at a minimum.

3. How to determine the P.R. of convergence:

   a. There are no objective methods of ascertaining the P.R. of convergence.

   b. Subjectively, if the patient can see single a point of light at infinity, then it is evident that he is maintaining convergence for that distance.

4. Definition of P.P. of convergence: It is the point to which the visual lines are directed when the eyes are turned inward to their utmost degree.

5. How to determine the P.P. of convergence:

   a. There are no objective methods of ascertaining the P.P. of convergence.

   b. Subjectively, if the patient can see singly with both eyes a dot at near distance, then it is evident that he is maintaining convergence for that distance.

6. Definition of amplitude of convergence: The amplitude of convergence is the full amount of convergence of which the eye is capable and is therefore the distance between the P.P. and P.R. expressed in M.A.

7. The amplitude of convergence can be obtained in several ways:

   a. Most common method.
      Find the nearest point at which single binocular vision may be maintained and convert it into Meter Angles.

   b. Another method consists of fixing the eyes upon a vertical row of type adjusted at 13"

then turning before the eye the maximum power of prism base out which can be fused at this distance. When to the power of this prism is added the prism dioptric power for 12" (usually 18 P.D.) the amplitude of convergence is determined.

C. Measurement of convergence.

1. Meter Angle.
2. Prentice's rule.

D. Types of convergence.

1. Positive convergence:
When the eyes move from a certain position inward.

2. Negative convergence:
When the eyes move from a certain position outward.

3. Tonic convergence:
That which is due to deranged tonicity of the lateral extrinsic muscles.

a. A person with exophoria of 3 P.D., since his eyes tend to turn outward or away from parallelism, has negative tonic convergence of 3 P.D.

b. A person with esophoria of 2 P.D., since his eyes tend to turn inward from parallelism, has positive tonic convergence of 2 P.D.

4. Fusional convergence.
That which is due to the effort made to make up for some kind of deficiency of convergence.

a. A person with exophoria of 3 P.D. has nega-

tive tonic convergence of 3 P.D. This is a deficiency and the fusion faculty sends an impulse to correct it, that is, instead of allowing the eye to turn out as it attempted by the action of the muscles, it keeps the eye in a state of parallelism using 3 P.D. of positive fusional convergence.

b. A person with esophoria of 2 P.D. has positive tonic convergence of 2 P.D. and in order that the eyes should stay in a state of parallelism there must be a 2 P.D. of negative fusional convergence.

5. Accommodative Convergence.

That which is due to the effort of accommodation.

Example:

At 13" we should accommodate 3 D. and in order to maintain single binocular vision we must converge 3 M.A. This convergence which has been the result of the necessity of accommodation is spoken of as accommodative-convergence. But these 3 M.A. are not the convergence that is all accommodative. The accommodative is only 2/3 or 3/4 of the total convergence and the other 1/3 or 1/4 is supplied by the fusion in the form of positive fusional convergence.

XI. PHYSIOLOGIC EXOPHORIA.

A. Fusional convergence is of the type that overcomes a deficiency. Upon converging to a point 1/3 meter on the median line there is a necessity to converge 3 M.A. The convergence due to accommodation supplies only about 2 M.A. and the fusion has to make up 1 M.A. of deficiency. Since positive fusion is required to supplement the accommodative convergence, it would be a case of exophoria. Owing to the fact that it is a physiologic process we term it "Physiologic Exophoria."

B. Definition of Physiologic Exophoria:

It is exophoria revealed by the muscle test at the P.P. and indicates the normal lag of convergence in relation to the accommodation.

C. Test for Physiologic Exophoria:

Prism base up over one eye ~~and~~ or base down over the other. Use 6-8 P.D.

D. Normal Range of Physiologic Exophoria.

1. From 4 to 6 P.D. (at 16 inches).

2. A change from this range designates a deficiency in the accommodative-convergence relationship.

E. Significance of Physiologic Exophoria.

1. Physiologic exophoria shows whether or not the accommodative-convergence relationship is normal.

2. Helps to make the necessary allowances in dynamic skiametry.

XII. RELATIVE ACCOMMODATION.

A. Definition:

It is that portion of accommodation that can be relaxed or exerted above a given degree of convergence.

B. Total Relative Accommodation.

It is the sum of the positive and negative relative accommodation.

1. Positive relative accommodation is that which can be exerted (minus lenses).

2. Negative relative accommodation is that which can be relaxed (plus lenses).

XIII. RELATIVE CONVERGENCE.

A. Definition:

It is that portion of convergence that can be relaxed or exerted with a fixed degree of accommodation.

B. Total Relative Convergence.

It is the sum of the positive and negative relative convergence.

1. Positive relative convergence is that which can be exerted (prisms base out).

2. Negative relative convergence is that which can be relaxed (prisms base in).

CHAPTER II

CROSSED CYLINDER TESTS

I. PRELIMINARY STATEMENTS.

A. The crossed cylinder powers in most common use for these tests are: +1⊖-1; +.50⊖-.50; +.25⊖-.25; axes always at right angles.

B. Accurate results from the use of crossed cylinders in those tests which are based upon the use of the astigmatic dial, depend upon the uniform and consistent action of accommodation under the condition provided.

C. Crossed cylinder tests based upon the use of the letter chart, depend for the information obtained upon the reduction or increase of the blur produced by the C.C. when turned to certain positions, as affected by inequalities in the curvatures of the eye or its correcting lens which serve to decrease or increase the astigmatic interval of the C.C. by neutralizing partly or wholly or by supplementing the cylindrical powers.

D. If there are no such inequalities present, the letters should be equally blurred as the C.C. are turned through all meridians.

E. If C.C. are placed before the E with minus ax. on meridian 90, they will, if the E is emmet., produce artificial mixed astig. with the rule; the plus cyl. producing myopic astig. and the minus cyl. hyp. astig. Should there be present in the E an astigmatism of exactly the same kind and amount, the real and artificial astigmatism would supplement each other producing an astigmatic interval twice as great. If we now turn the minus axis of the C.C. to meridian 180 the two combinations, real and artificial, will neutralize each other.

F. An artificial mixed astig. against the rule will correct the same amount of genuine astig. with the rule and vice versa.

G. If there is one best position of the C.C. there is also one worst position at right angles to it and positionsbetween these two are worse than the best and better than the worst. It is some modification of this principle upon which we rely for our information in all of the C.C. test for astigmia.

II. THE DIFFERENT WAYS FOR THE EMPLOYMENT OF THE C.C.

A. To verify distance test for sph. power as found by ordinary procedure.

1. Special chart is used; commonly called T chart.

2. Place C.C. before the correction with minus ax. at 90.

3. If the correction is exact, the blackest lines should appear in the meridians at right angle to the axes of the C.C.'s these being the meridians of maximum diffusion.

4. If more plus or less minus is needed the blackest lines should appear in the meridian at right angles to the axis of the minus cyl.

5. If less plus or more minus is needed the blackest lines should appear at right angles to the axis of the plus cyl.

B. To find correct reading addition in presbyopia.

1. Testing one E at a time.

2. T-chart is used.

3. With distance correction before the E hold C.C.

in front of correction with minus ax. at 90.

4. Place special astig. chart, (T-chart), at the desired working (reading) distance and supply the amount of plus sph. that will equalize the stripes.

5. If the lines at right angles to the minus axis are the darkest, increase the plus.

6. If the lines at right angles to the plus axis are the darkest, reduce the plus.

C. To determine the exact strength of the cylinder required.

1. Test letter chart is used.

2. Place minus ax. of C.C. over minus ax. of correction.

3. If the letters are less blurred than with C.C. in opposite position the minus cyl. of R_x should be increased.

4. If the letters are more blurred with minus ax. over minus ax. of R_x the power of the minus cyl. should be reduced.

5. Change cyl. power in the R_x until vision is the same when C.C. is turned through all meridians.

D. To prove the axis of the correcting cyl.

1. Test letter chart is used.

2. Hold minus ax. of C.C. at 45° in both directions from the minus axis of the R_x.

3. If the letters are equally blurred in both positions of C.C. the axis of the correcting

cyl. is properly located.

4. If the letters are plainer with one position than the other move minus axis of correction toward minus axis of C.C. until with minus ax. of C.C. at 45° on either side of the new position the letters are equally blurred.

5. Retest for strength of cylinder after changing the axis.

E. To determine whether or not a cylinder is needed when the issue is in doubt.

1. Test letter chart is used.

2. Rotate C.C. through all meridians.

3. If the letters are equally blurred with all positions of cross cylinder, no cylinder is needed.

4. If with C.C. in a certain position the letters are less indistinct cylindrical correction is indicated.

5. Try minus cylinders of gradually increasing powers in the position in which the minus axis of C.C. gave best vision until letters are equally indistinct when C.C. is turned thru all meridians.

6. Retest for possible change in sph. power in all cases in which strength of the cylinder is changed.

III. IMPORTANT NOTE.

In all tests with C.C. for astigmia refer the patient to the letters and not to the stripes when the C.C. is before the eye.

Phorometry.

A study of N. enervation of eye & ease or difficulty as the case may be with which this energy is supplied to the muscle

CHAPTER III.

THE MOST IMPORTANT MUSCLE TESTS IN THE PRACTICE OF MODERN PHOROMETRY

I. THE FOUR DISTINCT MUSCLE TESTS.

A. Version test.
B. Tonicity or seclusion or phoria test.
C. Fusion (formerly duction) test.
D. Accommodative-convergence test.

II. VERSION TEST.

A. What is it?

A strictly monocular test, a purely muscular test, a distinct muscle power test which shows the utmost power of each eye to turn in various directions as it naturally would in following a moving object without turning the head.

[Note: C of N: Version is the ability of the muscles to rotate the eyes in the four cardinal directions.]

B. The four principal directions:

1. Inward or nasalward called adversion.
2. Outward or temporalward called abversion.
3. Upward called superversion.
4. Downward called subversion.

C. Most common instruments for making version tests.

1. Perimeter.
2. Troposmeter.

III. TONICITY TEST (or seclusion, or phorias)

A. What is it?

A static binocular test which shows or

measures the direction of the visual axes when the fusion faculty is suppressed.

[Note: C of N: Tonicity tests are designed to ascertain the balance of the various extrinsic ocular muscles when in the physiologic rest position, that is, with the fusion suspended. Frequently called Phoria tests.]

B. Most common tonicity tests.

1. Cover test or seclusion test:

It consists in covering one eye while the other is directed toward a distant point of light. If, when the patient performs fixation with one eye, the other eye at the moment of uncovering, makes a movement of redress in order that it also may perform fixation, we know that binocular vision exists and that there is a deviation from orthophoria. If the deviation is inward, the eye has deviated outward under cover and there is a condition of exophoria. If the eye moves outward on being uncovered there is esophoria. If downward, hyperphoria, if upward hypophoria, that is hyperphoria of the other eye.

2. Duane's Parallax test:

This test is another method of applying the cover test, but instead of using it as an objective test and observing the movements of redress, we request the patient to say whether, as a card is passed quickly from one eye to the other, there is an apparent movement of the distant point of light. If the light appears to move to the right when the right eye is uncovered, there is homonomous diplopia (inward deviation): if it moves to the left when the right eye is uncovered, there is crossed diplopia (outward deviation) and so on.

3. Phoria test.

IV. FUSION TEST.

A. What is it?

A static binocular test which shows the extent of ocular rotations behind prisms when the fusion faculty is active.

[Note: Fusion tests really determine the breadth of fusion and not the total power of the muscles which is revealed by version test.]

B. Most common devices used.

1. Prisms from trial case.
2. Prism Bar.
3. Rotary prism.

V. ACCOMMODATIVE-CONVERGENCE TEST.

A. What is it?

A binocular dynamic test which shows the muscular status of the eyes at the reading distance especially for horizontal imbalance as affected by accommodation.

B. Technique of this test.

Repeat tonicity (phoria) test with fixation object at near distance.

Ex. Rec. out
Int. " in
Sup. Rec. up - in - Vert. axis in
Inf. Rec down - in - Vert. axis out
Sup. obl. down - out - Vert. axis in
Inf. obl. up - out - Vert. axis out

CHAPTER IV.

ACTION OF THE EYE MUSCLES

I. The six extrinsic muscles serve to rotate the eyeball around the vertical, transverse and antero-posterior axis, the center of rotation corresponding approximately to the center of the eye, and the movements being free in all directions like a ball and socket.

II. The movements which take place about the vertical axis are, adduction and abduction; those about the transverse axis are elevation or supraduction and depression or infraduction; those about the antero-posterior diameter are wheel rotation, torsion or cycloduction, by which the upper extremity of the vertical meridian is inclined inward (minus) or outward (plus).

III. MOVEMENTS OF THE EYEBALL BY THE EXTRINSIC MUSCLES.

A. External rectus moves the eye outward.

B. Internal rectus moves the eye inward.

C. Superior rectus moves the eye upward and inward and turns the upper extremity of the vertical meridian inward.

D. Inferior rectus: Moves the eye downward and inward and turns the upper extremity of the vertical meridian outward.

E. Inferior Oblique: Rotates the upper end of the vertical meridian outward and moves the eyeball upward and outward.

F. Superior Oblique: Rotates the lower end of the vertical meridian outward and moves the eyeball downward and outward.

IV. MOVEMENTS OF EYEBALL IN DUCTIONS.

In every movement of the eye, several muscles act at the same time as follows:-

A. Adduction.

1. Internal rectus.
2. Superior ~~oblique~~ rectus.
3. Inferior rectus.

B. Abduction.

1. External rectus.
2. Superior oblique.
3. Inferior oblique.

C. Elevation or Sursumduction.

1. Superior rectus.
2. Inferior oblique.

D. Depression or infraduction.

1. Inferior rectus.
2. Superior oblique.

CHAPTER V.

PARALYSIS OF THE MOTOR MUSCLES

	Affected Muscle and Nerve Supply		Nature of the a)Strabismus b)Diplopia	The affected eye is deviated:	The head is inclined and the diplopia increases on looking towards the:
I	External rectus (6th nerve)	Right	a)Convergent	Left	Right
		Left	b)Uncrossed	Right	Left
II	Internal rectus (3rd nerve)	Right	a)Convergent	Right	Left
		Left	b)Crossed	Left	Right
III	Superior rectus (3rd nerve)	Right	a)Divergent & downward	Right & down	Right & up
		Left	b)Crossed with false I* above	Left & down	Left & up
IV	Inferior rectus (3rd nerve)	Right	a)Divergent & upward	Right & up	Right & down
		Left	b)Crossed with false I below	Left & up	Left & down
V	Superior oblique (4th nerve)	Right	a)Convergent & upward	Left & up	Left & down
		Left	b)Uncrossed with false I below	Right & up	Right & down
VI	Inferior oblique (3rd nerve)	Right	a)Convergent & downward	Left & down	Left & up
		Left	b)Uncrossed with false I below	Right & down	Right & up

*I = image

[Note: Complete paralysis of the 3rd nerve involves all the muscles except the external rectus and superior oblique; the levator palpebrae superioris; the ciliary and the sphincter of the iris. The upper lid drops; the pupil is dilated; accommodation is absent; the eye projects. The strabismus is divergent and downward; the diplopia is crossed, the false image being above. Movements are limited in all directions except out and down.]

It also involves

CHAPTER VI.

VARIOUS POSITIONS OF THE EYEBALL - CORRESPONDING POINTS - THE HOROPTER

I. VARIOUS POSITIONS OF THE EYEBALL.

A. Primary:

When both eyes are parallel; the visual lines being horizontal (as in looking at a horizontal plane.)

B. Secondary.

1. The visual lines are parallel but directed upward or downward from the horizontal.

2. The visual lines are horizontal but converge toward one another (as looking at a small object near to and on the same level as the eyes).

C. Tertiary:

When the visual lines are not horizontal and converge toward one another (as in looking at the tip of the nose).

D. Listing's Law:

When the eye turns from the primary position to any secondary one it may arrive at the secondary position either by moving directly to its new position along the shortest route, or it may make two or more movements before arriving at the final position. Listing's Law simply states that no matter how the eye reaches the secondary position under consideration, the torsion is the same as if the eye had turned directly from the primary to the secondary position.

E. Listing's Plane:

It is a vertical, transverse plane, which contains vertical and transverse axes of rotation

and therefore also, a center of motion. In the primary position it may be considered co-incident with the plane of the equator.

F. Listing's Axes:
They are simply meridians of Listing's Plane.

II. CORRESPONDING POINTS.

Diagram for simple explanation of corresponding or identical points on the two retinae.

R and L represent the right and left retinae; O and O' the two yellow spots; A and A' same distance above are identical; O and O' are identical. But the corresponding point to B in the inner side of O in the right retinae, is B', a point to the same distance on the outer side of O' on the left retina are identical. Similarly, C and C' are identical. X and X' are not identical.

III. THE HOROPTER:

A. Meaning:
Oros----boundary; Opter----an observer.

B. Definition:
By this term we mean the surface containing all the points which would be seen single for any fixed adjustment of the eyes; that is, the horopter contains all the points whose images would fall upon corresponding points of the two retinae.

C. Shape of the Horopter: The shape of the horopter will vary with the position of the eyeballs.

1. In the primary position and in the first variety of the secondary, the visual lines are parallel. Hence, the horopter will be a plane at an infinite distance.

2. In the other variety of the secondary position and in the tertiary position, in which the

visual lines converge, the horopter is a circle which passes through the nodal point of the two eyes and through the point of fixation in the outer world at which the eyes are looking, and which will consequently fall on the two yellow spots. All other points in this circle will fall on identical points on the retinae.

IV. (C.O.N.) DEFINITION OF THE HOROPTER:

The horopter is a circle passing through the two nodal points and the point of fixation. Every point on such a circle has its images on corresponding points on the two retinae and is therefore seen singly.

V. CONSTRUCTION OF THE HOROPTER.

Mark the point of fixation and the two nodal points. Join to point of fixation with one N.P.; then erect a perpendicular bisector to this line. Join the two nodal points and erect the perpendicular to this line. The point of meeting of these two perpendiculars, is the center of the horopter.

CHAPTER VII.

DIPLOPIA AND THE CHIASMAL IMAGES

Let R and L represent the right and left eye, and O the point of fixation. Let R be the esophoric eye, since there must be esophoria if we are to have homonymous diplopia. L is the fixing eye and M_1 and M_2 the maculae. The visual axis of the right or esophoric eye must be directed to a point to the left of O that is M_1 and X. Let E represent the mean cyclopean eye, its macula M and its nodal point N on a line with O the object of fixation and with C the center of the Optic Chiasm. In the fixing eye L the image of O will be found at M_2 on a line through the nodal point. In the esophoric eye R the image of O will be similarly formed at I_1 on a line through the nodal point. This image will be to the left of M_1, the distance depending on the amount of esophoria. The two macular centers M_1 and M_2 are in relation with C the center of the optic chiasm. While those on a side of either M_1 or M_2 are proportionately away from O. The impression of image I_1 in the right eye being to the left of M_1 will be correspondingly projected in the chiasmal field to the left of C and at the same distance from it, say at I_2. The single eye E placed on a median line between the two eyes is termed the mean cyclopean eye. It presents in a fashion what is actually taking place in our act of vision, namely, the fusing of the two images into one and the projecting of this image on a line between the two eyes. We would get the same result as far as orientation of the object is concerned if instead of two laterally placed eyes we had only one eye medially placed and in line with the center of perception. The cyclopean eye is therefore used to project the images from the chiasmal field. This field is chosen for one reason, because it is here that the first meeting of the fibrils carrying impressions from the two eyes take place. We may therefore conveniently for diagrammatic purposes regard this chiasmal field

as the place where perfect or imperfect fusion takes place. The image in the left eye which is formed on the macula M_2 is projected to C, thence to M the macula of the cyclopean eye and thru the nodal point to O, where the left eye sees the object in its right place. Image I_1 is projected to the left of C, thence to the left of M to I_3 and thence thru the nodal point to O_1 which is the position of the false object seen by the right eye.

[Note: For an elementary understanding of the position of the displaced object with reference to the deviating eye, many books simply state that since the image of O in the right eye, (the esophoric eye), is formed on the inner or nasal side of the macula M_1, it is projected outward and is therefore at the side of the seeing eye (the right eye). But while the law of projection is corectly stated, it is incomplete and this causes the error. The others omit the important fact that "the images are projected thru the nodal point and not just projected."]

CHAPTER VIII.

TORSIONS

I. GENERAL CONSIDERATIONS.

A. Each eyeball receives the insertions of six extra-ocular muscles: (four recti and two obliques) and all motions of the globe take place under the action of these muscles.

B. The position of insertion of the attachment of these muscles is of great importance in influencing their action.

C. Drawing an imaginary line around the eye as an equator, parallel with the corneal boundary and situated at the greatest vertical circumference of the eye; we find that the recti muscles are all attached in front of this equator (near the cornea) and the oblique muscles behind this equator.

D. The first consequent action due to these different insertions is that when the superior rectus exerts a pull, the front of the eye (which by the way is the only part we see) turns up in the direction of the pull because the muscle is attached to the top of the eye at the front; but when the superior oblique acts, because of its pull is on the back of the eye it elevates the back and the front is depressed. Just the same thing happens when the inferior rectus and inferior oblique act. The inferior rectus depresses the eye because it is attached to the front and pulls down, whereas the inferior oblique elevates the front of the eye when it pulls the back of the eye down.

The internal and external recti being attached to the front of the eye and usually inserted in the same horizontal plane turn the eye directly in and out.

E. A further consequence of the anterior and posterior attachment of these muscles is that the recti tend to draw the eyeball deeper into the socket, whereas the obliques advance the eyeball and make it a little more prominent.

II. TORSION AND ITS VARIETIES.

The superior and inferior recti which are responsible for the major movements up and down are not inserted parallel to the corneal border but are both inserted somewhat obliquely, the superior slightly more external and tilted toward the nasal side and the inferior slightly more internal than the vertical meridian and tilted toward the temporal side. In consequence of this the uninfluenced action of the superior recti, while elevating the eye also turns it in and twists the eye so that the top of the vertical axis is also rotated in and similarly the inferior rectus in depressing the eye also turns it in and it rotates the eye so the upper end of the vertical axis is rotated outward.

The rotation of the vertical axis in this way is called torsion.

While the movements of the obliques are directly opposite to the recti, the torsion corresponds to the recti torsion. The superior and inferior recti always tend to converge to the line of direction. For example superior recti turn up and in, inferior recti turn down and in (both inward) the superior oblique turns down and out, the inferior oblique up and out. But the superior rectus and superior oblique have the same torsion (both rotating the top of vertical meridian inward) and the torsional effect of each the inferior rectus and inferior oblique torsions are similar (both rotating the top of vertical meridian outward).

The inward rotation is called minus or intorsion and the outward plus or extorsion.

III. THE THREE FORMS OF TORSION.

A. Torsion due to defect of design.

This is a physiological defect common to all eyes whereby the normal eye "torts" when extended to the limits of the visual field in certain directions.

B. Torsion due to Defect of Construction.

This is an anatomic irregularity. It may be due to either the internus or externus being set too high or too low (either below or above the horizontal line) or the obliques being set at some slightly different axis, thereby upsetting the physiological balance so that torsion occurs when the muscles are exercised in even the central field.

C. Torsion due to Defect of Function.

This is often pathologic; a true insufficiency of the obliques so that they are unable to fulfil their function of correcting the normal "torting" action of the superior and inferior recti.

[Note: This third form is the most common.]

IV. MOST COMMON AND PERSISTENT OF THE LOCAL SYMPTOMS OF TORSION OR CYCLOPHORIA.

A. Dryness of the eyelids.

B. Smarting of the eyes.

C. Sensation of grit in the eyes.

[Note: The above symptoms are due to hyperaemia caused by the pressure of the lids preventing the tendency to roll.]

D. Pain often situated over one or both eyebrows caused by the muscles acting to elevate or depress the brows in assistive correction.

V. VARIOUS TESTS FOR TORSION OR CYCLOPHORIA.

A. Double-Prism Test.

With one eye closed we hold before the other eye a double prism so that its double base bisects the pupil horizon tally and then look through the prism at a horizontal black line on a white ground at a distance of about 13". We see two parallel lines. If we now open the other eye we see a third line between the two other lines. If the meridianal adjustment of the eyes is perfect all three lines will be parallel and horizontal: but if there is a tendency to deviation of the meridians of the eye from their proper adjustment, the third line will be obliquely inclined to the other two lines.

B. Maddox Rod Test.

In this test we place a rod vertically before each eye. The two lines of light as seen through the rods should form a continuous horizontal line; or place 3 △ base down over either eye when two parallel horizontal lines should be seen. Any deviation of either line from the horizontal plane indicates cyclophoria and the angle through which the rod must be turned in order to make the line appear horizontal measures the cyclophoria.

C. Cone Test (old).

A cone of glass, cemented onto a ground glass disc is mounted and centered before one eye the other being meanwhile covered with an opaque disc. Attention is directed to a candle flame. The cone draws the flame out into a circle of light. The other eye now is uncovered. If there be no imbalance the candle flame will be seen erect in the center of the circle of light. If there be cyclophoria the flame will be tilted obliquely and the direction in which it is tilted will indicate the variety of the cyclophoria.

D. Test with the Clinoscope. (Stevens).

This is a good instrument for detecting cyclophoria. It consists of two tubes nearly 20" long mounted on a brass platform. The attachment to the platform permits the tubes to be adjusted to parallelism, in convergence or in divergence and the platform itself is attached by a movable joint to an upright standard so that the tubes can be given any desired dip simultaneously. The tubes can be rotated about their longitudinal axes by thumb-screws and this motion is recorded by an index-pointer above each tube. At the far end of each tube provision is made for maintaining diagrams in position. The diagrams represent two pins one to be seen by each eye.

The heads of the pins blend and by rotating one till the pins form a continuous straight line the latent torsion is measured.

[Important Note: This instrument serves to measure the strength of the faculty of fusion. Similar disks are used as targets but with a complete diameter instead of a radius on each.

These diameters are fused and by rotating both in opposite directions until they begin to separate, the strength of the faculty of fusion is measured.]

VI. RULES FOR REGULAR OFFICE PRACTICE (simplified from the original five "Steele Rules" of Dr. Steele of Chattanooga; and slightly amplified by Savage with the addition of a sixth rule).

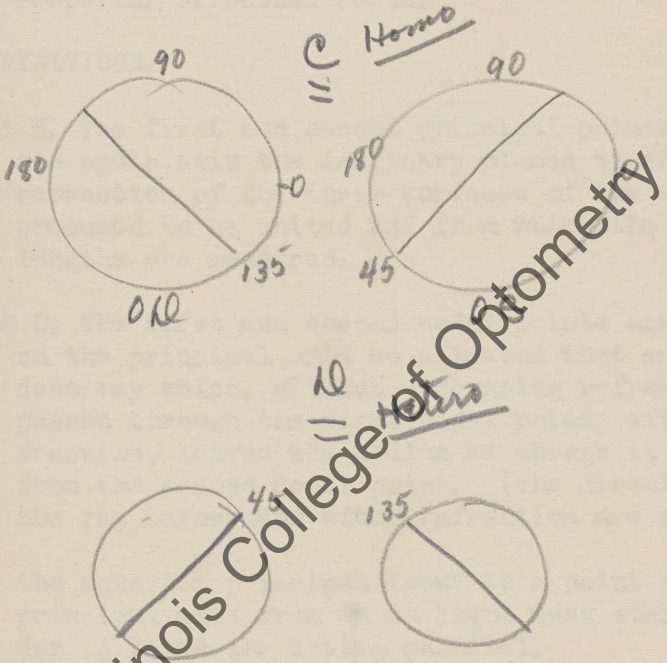
A. Regard + cyclophoria with hyperopic astigm. (+ cyls.) or minus cyclophoria with myopic astig. (minus cyls.) as homonymous cyclophoria (that is the notation of cyclophoria and astigmia both plus or both minus in the individual eye and does not refer to the similar or dissimilar character

of the cyclophoria in the two eyes).

B. Regard + cycl. with myopic astigmia (minus cyls.) or minus cycl. with hyp. astig. (plus cyls.) as heteronymous cyclophoria (the cyclophoria and the astig. are of opposite notation.)

C. In homonymous cycl. set the cyls (either + or -) as near as possible to the center of the lower nasal quadrant. (R.E. 135°; L.E. 45°.)

D. In heteronymous cycl. set the cyls. as near as possible to the center of the lower temporal quadrant. (R.E. 45°; L.E. 135°).



CHAPTER IX.

CARDINAL POINTS OF THE EYE

I. According to the theory of Gauss, every optical system (composed of more than two refracting surfaces in which all the centers of the surfaces are on the axis and the apertures of the surfaces are small), has six cardinal points.

A. First Principal Point.
B. Second Principal Point.
C. First Nodal Point.
D. Second Nodal Point.
E. Anterior Principal Focus.
F. Posterior Principal Focus.

II. DEFINITIONS.

A & B. The first and second principal points mark on the optic axis the imaginary planes at which the refraction of the three surfaces of the eye is presumed to be united and from which the focal lengths are measured.

C & D. The first and second nodal points are points on the principal axis so situated that an incident ray which, without undergoing refraction, passed through the first nodal point; after refraction, leaves the medium as though it came from the second nodal point. (The directions of the ray before and after refraction are parallel).

E. The anterior principal focus is a point on the principal axis from which light must start in order to leave the system parallel.

F. The posterior principal focus is a point on the principal axis where parallel rays will meet after being refracted by the optical system.

III. TABLE OF CARDINAL POINTS AND DIAGRAM.

A. Table.

1. First Principal Point, 1.77 mm. from anterior pole.
2. Second Principal Point, 2.14 mm. from anterior pole.
3. First Nodal Point, 7.09 mm. from anterior pole.
4. Second Nodal Point, 7.46 mm. from anterior pole.
5. Anterior Principal Focus, 14.27 mm. from anterior pole.
6. Posterior Principal Focus, 23.5 mm. from anterior pole.

IV. ANTERIOR AND POSTERIOR FOCAL DISTANCES.

A. The anterior focal distance is the distance of the anterior principal focus from the first principal point, (14.27 + 1.77 = 16.04). It is equal to the distance of the second nodal point from the posterior principal focus, (23.50 - 7.46 = 16.04).

B. The posterior focal distance is the distance of the second principal point from the posterior principal focus, (23.50 - 2.14 = 21.36 mm.) The posterior focal distance is equal to the distance of the anterior principal focus from the first nodal point. (14.27 + 7.09 = 21.36).

C. Consequences:

1. The distance of the first principal point from the first nodal point is equal to the distance of the second principal point from the second nodal point.

2. This distance (5.32 mm) is equal to the difference between the focal distances.

3. The distance between the two principal points

is equal to the distance between the two nodal points.

V. Method of finding the cardinal points of any given system in general and of the ocular optical system in particular.

CONSTRUCTION

A. Draw an incident ray parallel to the axis. Where this ray meets the principal axis after refraction will give us the posterior principal focus.

B. Prolong the incident and emergent rays just as if they were not undergoing any refraction and the point of their intersection will be situated in the second principal plane.

C. Draw from this point the perpendicular to the principal axis. This will mark the second principal point.

D. Repeat the same construction with a ray parallel to the axis coming from the other side and we will find the anterior principal focus and the first principal point.

E. Knowing these four points we can deduct the position of the two nodal points.

CHAPTER X.

MOST IMPORTANT PATHOLOGICAL SUBJECTS FOR THE OPTOMETRIST

I. EYELIDS:

A. Blepharitis (especially Marginalis)
B. Hordeolum.
C. Ptosis.

II. CONJUNCTIVA:

A. Pink eye.
B. Trachoma.
C. Pterygium.

III. CORNEA:

A. Keratoconus.
B. Arcus-senilis.
C. Nebula-macula-leucoma.

IV. MIDDLE TUNIC:

A. Iritis.

V. RETINA:

A. Retinitis in general. (As a guide).
B. Retinitis Albuminurica.
C. Retinitis Diabetica.
D. Retinitis Pigmentosa.
E. Detachment of the retina.
F. Thrombosis.
G. Embolism.

VI. OPTIC NERVE:

A. Choked Disc.
B. Optic Neuritis.

VII. LENS:

A. Cataract (fully as possible).
B. Aphakia.

VIII. GLAUCOMA:

Fully as possible.

IX. THE THREE CUPS:

A. Physiologic.
B. Glaucomatous.
C. Atrophic.

X. MYOPIC CRESCENT:

XI. TABLE OF DIFFERENCES BETWEEN CONJUNCTIVAL AND CILIARY INJECTION.

XII. DIFFERENTIAL DIAGNOSIS BETWEEN:

A. Acute Conjunctivitis.
B. Iritis.
C. Keratitis.
D. Glaucoma.

CHAPTER XI.

EYE SYMPTOMS IN GENERAL DISEASES

I. GENERAL STATEMENTS.

A. The eye is not an isolated entity, but exactly as integral and intimate a part of the body as the stomach or the kidneys or any other of the internal organs.

B. The eye is an exceedingly sensitive receptor and recorder of organic and functional disturbances very much like the "trouble lamp" on an electrical system; so that in many instances it is the gateway to the diagnosis of all sorts of bodily ills.

This is particularly the case for three important reasons:

1. The eye is vascularly regarded as an end-organ; that is to say its circulation represents a terminal arterial loop with an anastomosis so that the circulating toxins are almost bound to accumulate in it and affect it. In this respect it resembles the kidneys which accounts for the fact that so many diseases which attack the kidneys manifest themselves also in the eye.

2. The fundus of the eye, the retina and the optic disc constitute a visible outpost -- indeed the only visible portion -- of the central nervous system, being in fact a projection of the brain.

Every affection of the central nervous system, therefore, registers itself in some fashion and in some degree upon the fundus of the eye.

3. The eye is functionally related to practically every other part and function of the body and its own function is so complex, so delicate and

so indispensable to comfort and usefulness that disturbances of health are quickly registered in and noticed by disturbances of vision.

C. In all classes of disease there are two sets of symptoms: subjective and objective.

In the case of diseases of the external eye these two groups of symptoms manifest themselves in similar fashion to those elsewhere in the body.

But when we come to diseases of the internal eye we are in the realm of special ocular diagnosis for which special methods and apparatus are necessary. The eye being the organ of vision, subjective symptoms of internal eye disturbances are naturally visual symptoms -- defects in the visual field. For the detection of objective signs in the structures of the fundus the ophthalmoscope is indispensable.

II. COMMON SUBJECTIVE SENSATIONS.

A. Floating Specks.

In the great majority of cases muscae volitantes do not indicate any systemic disease.

The important thing is to find out whether the specks seen by the patient are fixed or move about when steadfastly looked at. If they move they are of no special import. If, on the other hand they remain constantly in the same line of vision, then it is quite probable that they represent some real ocular lesion, which, in turn, may indicate some systemic disease. If there is any doubt, an examination with the ophthalmoscope is necessary to clear up the diagnosis.

B. Flashes of light.

In investigating this symptom it is important first to make sure that what the patient is describing is not the aura of migraine.

If we are assured that they are genuine flashes of light then the cause is some mechanical stimulation of the retina and the symptom is always a serious one. They are usually due to irido-cyclitis, the congestion in the ciliary body causing a tiny pull on the front of the retina. Therefore flashes of light associated with misty vision is probably indicative of irido-cyclitis.

C. Photophobia.

Dislike of light is rather a frequent symptom. It occurs in such a large number of eye conditions from simple Stye to Optic Neuritis that it can not be regarded as having any definite meaning in itself.

D. Night Blindness.

This condition usually indicates impaired nutrition or actual destruction of the elements of the Retina and Choroid, which, in turn, is the manifestation of a systemic disorder.

It is a symptom of Retinitis Pigmentosa and of Syphilitic Retinitis.

E. Day Blindness.

It occurs usually in persons past middle age and suggests either tobacco or alcohol toxemia or the beginning of Optic Atrophy. It must not be forgotten, of course, that this is often one of the accompaniments of a cataract, because under strong light the pupil contracts and no light waves can enter the eye around the margins of the cataract.

F. Color Blindness.

When this is congenital, it has no disease significance. When however it occurs in one whose color vision was formerly normal, it usually indicates either Tobacco Neuritis or Optic Atrophy, the latter possibly due to locomotor ataxia (a disease of the posterior columns of the spinal cord.)

G. Double Vision.

The occurrence of diplopia in one who has heretofore been normal, especially one of middle age or past, must always be regarded as a serious symptom. The roots of the nerves which control the muscular movements of the eyes are in the floor of the fourth ventricle of the brain and their coordinate action is regulated by precisely the same mechanism as that which controls coordination in general.

A failure of this muscle action, therefore, naturally indicates either a brain lesion involving the fourth ventricle, a peripheral paralysis of one of the ocular nerves, or a disease of the coordinating system, whether of the cerebellum or of the posterior spinal columns. In any of these events we are dealing with a grave disease of the central nervous system.

III. NYSTAGMUS. Involuntary rythmic movement of eyes generally laterally.

It may be produced by various diseased conditions as alcohol or tobacco poisoning, intestinal intoxication, sea-sickness, brain abscess and tumor, meningitis, fracture of the skull, mastoiditis (mastoid nipple-shaped as the mastoid process of the temporal bone) and internal ear disease.

IV. THE PUPIL.

A. Shape.

In health the pupil is almost always perfectly circular. Distortions are practically always due to local, mechanical causes. The dragging of the iris in one or more directions either by reason of being stuck to the lens or cornea by exudates or being caught in a wound of the cornea or limbus is not an unusual occurrence.

The former occurs in iritis, the latter as a complication of accidents or operations.

B. Size.

The size of the pupil in health is difficult to specify because it is continually varying under physiological stimuli. What may be called its absolute or constant diameter (3.5 mm) is a personal idiosyncrasy; since light is a more or less constant factor that is the same for all individuals. It is to the action of the sympathetics or dilators that we must look for an explanation of the individual variations in the size of the pupil. In general it may be said that sensitive, neurotic persons, whose sympathetics are easily excited and react readily, have large pupils than more phlegmatic individuals.

C. Variations in the Size of the Pupil due to Abnormal or Pathological Causes.

1. Mydriasis (dilation of the pupil).
It is caused by:

a. Any condition which paralyzes the central or peripheral ending of the 3rd nerve or the short ciliaries, as tumors of the brain or along the 3rd nerve, toxins of infectious diseases, and the action of certain drugs (notably bella donna).

b. Any condition which inhibits the functioning of the 3rd nerve through the brain as fevers, comatose conditions (unconsciousness from which the patient cannot be aroused by external stimulus) and excited conditions of the brain.

c. Any condition which stimulates the sympathetics as pain, sensory irritation and abdominal diseases.

2. Myosis (contraction of the pupil).
It is caused by:

a. Any condition which irritates the third nerve as photophobia from whatever cause, meningitis and certain drugs such as eserin and pilocarpin.

b. Any condition which depresses the sympathetics as spinal diseases, aneurysms by pressure on the nerves (a circumscribed dilation of the walls of an artery) and opium.

3. Normally the two pupils are equal in size.

4. Inequality is practically always due to interruption of the motor-oculi nerve path either centrally as in brain tumors, syphilis, tubercle of the brain; or peripherally as in injuries to the eye and toxins from infectious diseases.

5. Occasionally one pupil is dilated because of pressure on the cervical sympathetics by an aneurysm.

6. Optic atrophy, choroiditis and any disease which interferes with light stimulus on the retina will also produce unilateral dilation.

7. In health the pupil reacts with great quickness and sensitiveness to stimulus on both sides of the nervous circuit, that is, to light and to sensory stimulus. A sluggish or immobile pupil which is not due to adhesion of the iris may be due to paralysis of the 3rd nerve central or peripheral.

8. Argyll-Robertson pupil is a pupil which fails to contract to light but contracts upon accommodation and occurs in locomotor ataxia supposed to be due to the involvement of Meinert's fibres.

9. Wernicke pupillary reaction is a test for determining the location of a lesion in the optic tract employed in cases of hemianopsia. If the

light reflex is present in the blind half of the eye then the lesion is back of the optic thalamus, if not it is in front of this ganglion because at that point the reflex and optic paths part company.

10. Hippus is a periodic contraction and dilation of the pupil which is seen in psychic diseases, mania, hysteria etc.

V. HEMIANOPSIA.

Usually indicates a grave brain lesion, but it is occasionally due to hysteria; and certain cases of fleeting hemianopsia have been shown to result from autointoxication.

VI. EXTERNAL EYE AFFECTIONS.

The great majority of such eye diseases are local infections, pertaining only to the structures which they involve, therefore they have no systemic significance.

However, a few of them do appear to be manifestations of systemic disturbance.

They are the following:

A. Blepharitis: a symptom of malnutrition.

B. Phlyctenular Conjunctivitis: a symptom of poor general health due either to malnutrition or to chronic infection.

C. Interstitial Keratitis: in the great majority of cases a symptom of congenital syphilis.

VII. INTERNAL EYE AFFECTIONS.

A. Affections of the Contents of the Globe.

One alone may be regarded as the typical and comprehensive manifestation of systemic disease, namely, iritis, or more correctly, iridocyclitis, since the entire uveal tract is always

more or less involved in a cast of iritis. The extreme vascularity of the iris makes it a ready victim of infection. Its numerous vessels become badly congested. Its tissues swell and are pushed against the cornea and exudates are poured out which often glue the free margin of the iris tightly to the lens. Pain is severe, being felt in the brow rather than in the eyeball and is worse at night. Congestion is seen as a pink flush in the deep vessels of the eye; the iris loses its soft luster and appears dull and ragged, and if adhesions have taken place, the pupil is no longer circular but irregular. The exudates cloud the aqueous and dim vision.

Except in penetrating wounds of the eyeball irido-cyclitis is always part of a systemic infection. Rheumatism, syphilis and tuberculosis are the three commonest causes; but it not infrequently results from an infected tonsil, sinus or tooth and sometimes from even more remote foci such as the prostate, gall-bladder etc. (The organ surrounding the neck of the bladder).

B. Fundus Manifestations.

1. Choroid. (
2. Retina (See Ocular Pathology notes.
3. Optic Nerve (

CHAPTER XII.

MALINGERING - PRETENDED BLINDNESS

I. INTRODUCTION.

Malingering is one of the most important and most difficult problems the refractionist of modern times has to meet. (Very little literature - not much taught in schools or colleges - most practitioners at a loss when confronted with such cases).

II. MOTIVES.

When a person is malingering he or she has a motive behind it. (To collect damages as a result of a supposed or real injury -- in this modern day of the automobile and its many accidents, of life insurance with total and partial permanent disability clauses, and of sick and accident insurances, and workingmen's compensation laws, optometrists are bound to find individuals who are trying to obtain compensation or insurance on the smallest pretext.)

Sometimes malingerers claim greater defect or loss of eyesight than really exists in order to secure greater judgments for the injury of the eyes.

Others pretend blindness in order to secure pensions; some to avoid military service; and some in order to be admitted to some charitable institution.

Sometimes children pretend blindness in order to be relieved from school work.

III. THE THREE CLASSES INTO WHICH MALINGERING MAY BE DIVIDED:

A. Total Blindness in one eye.
B. Partial Blindness in one eye.
C. Total or Partial Blindness in both eyes.

1. Total Blindness in one eye.

a. Objective tests.

1'. Pupil Reaction:

To test the pupillary reaction the subject under examination is directed to look forward. The examiner covers both eyes with his hands. The hands are quickly removed and the reaction noticed. If the pupil reacts to light there is evidence of some sight and the better the reaction the more vision there is. The degree of sight can not be measured by this test. There is however a positive value to this test. If there is no contraction of the pupil to which the light is applied and there is a reaction of the pupil of that eye to which the light was not applied (consensual reaction taking place); there is evidence that the eye is blind.

2'. Vision fixation test.

When an eye is partially or totally blind it fails to maintain proper fixation. If perfect parallelism exists there is a good proof that there is some sight present. The sight may not be as good as in the other eye but at least it is good enough to produce and maintain binocular single vision.

3'. Ophthalmoscopic examination.

This is very essential because blindness may exist as long as there is found a fundus lesion or some pathological condition of the choroid or retina or cloudy media.

b. Subjective tests.

1'. Binocular Bar Reading Test.

While the patient is reading small type on reading card at near, a

pencil is held in front of the card by the examiner. The ability to read uninterruptedly proves that both eyes are functioning as the pencil cuts off the letters and words from each eye on different places on the card and it could not be read monocularly without interruption.

2'. Duane's Method.

Have the patient read aloud and quite rapidly. While the patient is occupied with what he is doing, quickly place a 4PD prism base down in the front of the alleged blind eye. The examiner should be certain that the eye is open at that time. If the eye is totally blind or vision is very poor the placing of the prism will make very little difference in the reading. He will be able to read just as well as before the prism was placed in front of the eye. But if there is some sight in that eye he will not be able to read or will at least stumble, as the placing of the prism will produce double vision.

3'. Pin Hole Test.

Place a pin hole disc in front of the good eye so that the small hole is as near the center of the pupil as possible. Have the subject read at distance or at near. His head is then to be slightly tilted downward till the visual line comes above the pin hole. If the subject is still able to read he is doing it with the alleged blind eye.

2. Partial Blindness in One Eye.

a. Objective tests.

Same as those described under total blindness.

b. Subjective tests:

1'. Jackson's Convex and Concave Cylinder test. Place a +6D Cyl. and a -6D Cyl., axes parallel, in front of the good eye so that the one lens neutralizes the other. Have patient read on distant test chart and turn front cyl. slowly till the axis of one cyl. is perpendicular to that of the other cyl. If patient is still able to read he is doing so with the poor eye.

2'. Snellen Color Test.

This test is performed by using a chart made up of a series of transparent Snellen letters alternately red and green in a frame. A red lens of such a shade as to entirely quench the red letters are placed in the trial frame. The chart of the transparent letters is to be hung on a window with plenty of illumination. Then, for instance, if the patient claims his left eye to be the poor eye and the red lens is placed in front of the right eye he should be able to read the red letters only and the green letters will appear to him black and not distinguishable. If, however, he can also read the green letters he sees those with the alleged poor eye. The acuity of vision can be measured by the size of letters he reads on that chart. The principle of this test lies in the fact that while rays of a similar color may pass thru a colored glass, rays of a complementary color are stopped. This test is very

valuable and is easily and quickly performed; but care must be taken that the colored lenses are of such a shade as to quench completely the ~~complementary~~ corresponding colors of the transparent letters.

3'. Special test card.

Instead of commencing with the single top line 20/200 letter, the test chart should commence with the 20/70 or 20/50 letter. Many claimants for disability or accident insurance who have some defect or injury in one eye try to exaggerate and are fully determined to read only the first letter on the chart. This chart then eliminates this class of exaggerators as nearly all of them read the first letter without difficulty which is, as the case may be, 20/70 or 20/50.

4'. Test with the Worth Amblyoscope.

By properly using the Worth Amblyoscope the examiner is able to not only detect malingering for himself but can also prove it to others. To make this test the amblyoscope should be so arranged that the images are crossed when looking thru it with normal eyes. The amblyoscope should be placed on the table in such a manner that the patient shall clearly see that the tubes do not cross. Now let us take two objects say a bird and an arrow. The bird will be placed in the tube which will be seen by the right eye (the blind eye) and the arrow which is larger than the bird be placed in the tube seen by the left eye (the seeing eye). It should be remembered that the amblyoscope is so arranged as to have the images crossed so that the arrow will be on the right though seen

by the left eye and the bird on the left though seen by the right eye. If the claimant is malingering he will claim to see only that object on the side of the seeing eye, in this case the bird, which in reality is seen with the eye claimed to be blind. This is conclusive proof that the claimant not only is malingering but also has good sight in the right eye.

3. Total and Partial Blindness in Both Eyes.

a. Important Statement.

Simulated total blindness in both eyes is unusual because it is difficult to carry out. This may be pretended by persons who have amblyopia in both eyes or by hysterical persons.

A real totally blind person has definite and peculiar characteristics. He has a dull stare; his eyes are turned upward and slightly outward; he has an expressionless face and walks hesitatingly.

b. Objective tests.

Same as for any other form of malingering.

c. Subjective tests.

1'. The examiner may pretend that he is testing the sense of direction. He may go to one end of the room and ask the patient to approach him. A piece of furniture may be placed in his way and the examiner should observe whether or not the patient is trying to avoid the objects placed in his way. Care must be taken that the patient should not get injured.

2'. Schmidt-Rimpler test.

The patient is told to look at his own hands which he holds a short distance from his eyes. If he looks in a different direction he is only a pretender and believes that he is in this way deceiving the examiner. A blind person can easily succeed in casting his eyes in the direction of his hands.

3'. Van Waltz test.

The patient is placed in a semi-darkened room. A candle light is to be placed in front of him so that he will naturally cast his eyes in the direction of the candle without being instructed to do so. A prism base in is placed in front of one eye. If vision exists the eye will move outward and again inward when the prism is removed.

CHAPTER XIII.

OPTOMETRIC SALES PSYCHOLOGY

I. IMPORTANT STATEMENT:

Professional service must be sold; but we must sell optometric service ethically.

II. USUAL BUYING MOTIVES.

A. Profit or gain.
B. Fear.
C. Envy.
D. Pride.
E. Comfort or Convenience.
F. Love or affection.
G. Protection.

III. CHIEF REASONS WHY A PATIENT PURCHASES OPTOMETRIC SERVICES:-

Practically everything sold is purchased, principally, for only one of the above mentioned reasons, but the chief reasons why a patient will purchase Optomatric services are:-

A. Comfort or Convenience.
B. Pride.
C. Fear.

IV. COMFORT OR CONVENIENCE.

In appealing to the principal buying motive 'comfort or convenience,' we have one of the most important phases of Optomatric sales psychology under consideration, because a large percentage of patients who enter the Optometrist's office have uncomfortable vision.

Instilling confidence in the one who is interviewing you, the fact that you are able to care for his condition, and presenting your facts correctly, impresses the patient to the point that he is convinced that your service is what he requires and the

sale is consummated. It naturally follows that the convenience that will be afforded the patient after the condition has been corrected is self evident.

V. PRIDE:

The second most important buying factor is the factor of pride. This is perhaps due, chiefly, to the habit instilled in us by our parents from the time we were infants, "the desire to look our best;" so the adaptation of your Optometric service to your patient must to a general degree flatter his appearance.

VI. FEAR:

The third buying factor is fear. It should be entered into diplomatically and should not be appealed to unless the condition so warrants. If you consider the condition such that upon neglect it may develop and reach such a stage that correction will be more difficult or perhaps impossible, this factor of fear must be appealed to or you are doing your patient a great injustice.

It is perfectly ethical to appeal to this factor if in your mind the circumstances justify it, whether your services are applicable or whether you are referring the patient to another specialist.

VII. GENERAL CONSIDERATION:

A. The Optometrist must impress the patients with the ever-present feeling that they are interested in their eyes above all else and that it is only secondary to the interest of their eyes that he is accepting the case.

B. Do not under-rate your services. If you do the patient will readily sense it through his so-called instinct. Cheap service is generally associated with poor service.

The patient judges a professional man not only by the kind of service but by the cost of service. It

is human nature to want to feel that the one who serves us is the biggest and best specialist in his field.

C. There is a very important psychological impression made in working by appointments only. It is evidence to the public just how valuable your time really is.

D. Nothing portrays to the patient more quickly the type and condition of the Optometrist than his office and surroundings. The psychological working of the patient's mind is somewhat as follows:

"If his office is poorly planned and maintained the Optometrist must be poor; and if he is poor he must not be very busy; and if he is not busy he cannot be a very good Optometrist." Therefore, a reasonably well equipped and maintained office, although it may be a small one, impresses the patient greatly with the Optometrist's prosperity. A professional man must be professionally attired, and his assistant likewise.

The above Psychological factors are very important and register in the patient's mind much deeper than we often realize.

CHAPTER XIV.

ROUTINE OF THE EXTERNAL OCULAR EXAMINATION.

I. The external examination may be divided into three parts:

First: Inspection, using one of the three methods:-

a) Magnification.

b) Oblique illumination.

c) Slit lamps.

Second: Palpation.

Third: Functional Tests:-

a) Light sense.

b) Form sense.

c) Color sense.

d) Muscular equilibrium.

First and Second Part

EXTERNAL OCULAR INSPECTION AND PALPATION

I. GENERAL EXTERNAL EXAMINATION OF THE EYES.

A. General appearance of the eyes.

1. Are they very far apart?

2. Are they horizontally on plane, one with another, or is one higher than the other?

3. Is any other type of facial or ocular deformity present?

B. General Appearance of the Orbit.

1. Any inflammation present?

2. Any injury?

II. MORE DETAILED EXAMINATION OF THE VARIOUS PARTS OF THE OCULAR REGION.

A. Careful inspection of the eyeballs.

1. Position.

a. Are they normally in position?
b. Are they deep seated?
c. Are they protruding?

2. Size.

a. The normal eyeball of a child is from 18 to 21 mm. in diameter.

b. The normal eyeball of an adult is from 21 to 27 mm. in diameter.

3. Symmetry.

4. Tension.

a. The tension can be estimated by means of palpation:

Direct the patient to look down with the eyes closed, and place your index finger on the upper lid and palpate the sclera above the cornea, pressing gently downward.

b. Record tension of each eye:

Tn normal tension.
Tn+ increased tension.
Tn- diminished tension.

c. Importance of this step.

(1) Increased tension is one of the diagnostic tests for Glaucoma.

(2) Taking the tension gives the examiner information regarding the presence or absence of sensitiveness in the ciliary region.

B. Examination of the lids.

1. Color.
2. Thickness.
3. Size of the palpebral fissure. About 30 mm. on an average.
4. Ability to move the lids:

a. Ptosis. (adipose ptosis)
b. Blepharospasm. Tonic spasm
c. Nictitation. Clonic spasm?
d. Lagophthalmos.

5. Malposition of the lid margins and lashes:

a. Entropion.

b. Ectropion.
c. Trichiasis.

6. Condition of lid edges:

a. Swellings.
b. Crusted areas.
c. Ulceration.

7. Conditions and position of the puncta.
8. Regurgitation. Press on sac to force liquid thru puncta.
9. Examination of the conjunctival epithelium of the lids:

a. Evert upper and lower lids and note color, surface and transparency of the conjunctiva.
b. Look for ulceration, scars, granulation and thickening.

C. Anterior ~~position~~ portion of the eye.

This examination can best be done by the aid of a slit-lamp, or by means of focal (oblique) illumination.

1. Bulbar conjunctiva and cornea.

a. Color.
b. Thickening.
c. Opacities.
d. Scars.
e. Vascularization. Pannus most common
f. Inflammation.
g. Ulcers.
h. Size and form of cornea.

2. Sclera.

a. Color.
b. Staphyloma of the sclera.
c. Episcleritis.
d. Scleritis.
e. Pterygium.

D. Anterior Chamber (aqueous humor)

1. Depth. deep chamber in Eritis; shallow in Glaucoma
2. Clearness of contents.

E. Lens.

1. Presence or absence.
2. Position.
3. Color.

F. Iris (1/6" wide).

1. Position.
2. Malformations.
3. Adhesions.
4. Signs of iritis.

G. Pupil.

1. Position.
2. Shape.
3. General size.

O glaucoma

H. Pupillary reactions.

1. To light.
2. To accommodation and convergence.

Part Three.

FUNCTIONAL TESTS

A. Examination of light sense.
By means of a rheostatic control of the lamps on the test chart.

B. Examination of form sense.
Test the vision.

C. Color sense.
The color slides on the test chart.

[Note: If after the partial examination of the above functions, any should appear abnormal, further study of them should be made.]

D. Muscular Equilibrium.

1. Cover test (motion is always opposite to deviation).

2. Rotation and Version.

1. What are the two most important points in an ocular examination?

a) To get accurate data regarding elements of weakness and of strength, deficits and resources of all functions involved.

b) From such data, to render such assistance as would tend to coördinate and efficiently correlate the eyes in their work of seeing distinctly with comfort and with binocular single vision.

2. Of what should ethical practice consist?

Ethical practice should consist in:

a) Giving first consideration to the patients interest

b) Extending such courtesys to his fellow practitioners as he would like to receive from them, in short,

II. IMPORTANCE OF THE EXTERNAL OCULAR EXAMINATION.

A. The data obtained in the external examination is invaluable as an indicator of pathological conditions of the eye.

B. As a great help during the remainder of the examination.

C. The psychological value of the tests during the external examination in impressing the patient with the thoroughness and knowledge of the optometrist can never be given its true valuation.

applying the golden rule:
c) In personal publicity, adhering at all times to truth and avoiding all representations which may admit of double interpretation.
d) In not featuring in his advertising:
x) free examination, y) cut-rate on glasses
z) prices of glasses.

CHAPTER XV.

EYESTRAIN

I. General consideration of the effect of a leakage of nerve force caused by eyestrain upon the nervous system.

A. Eyestrain arises chiefly from errors of refraction and imperfect equilibrium of the muscles which move the eye.

B. These conditions where present, tend to cause an excessive expenditure of nerve force by the individual in direct proportion to the amount of the defect to be overcome.

C. Excessive expenditure of nerve force on any one organ is commonly made at the expense of some other organ or if not, is paid by the reserve amount of nerve capital possessed by the individual.

D. The extent of the draft made upon the "reserve capital" and the amount of "reserve capital" are the factors which can alone determine in any individual case how long this state of things can last without causing "nervous bankruptcy."

E. The conditions mentioned as those which chiefly tend to cause eyestrain are transmitted from parent to child; hence, they become operative at birth and last until death unless mechanically relieved.

F. They are capable of detection and accurate measurement during life by scientific procedure.

G. A condition of exhausted nervous vitality is sure to impair the general health in many ways and to render the individual more liable to disease than when in full vigor.

H. Many of the constitutional diseases which ultimately imperil the general health are indirectly the result of a state of low nervous vitality, a state which is frequently the result of eyestrain from well understood causes that might have been easily recognized and relieved.

I. The so called "inherited predisposition" to certain diseases is unquestionably based, in many cases, upon some anomaly of the visual apparatus.

J. The examination of the eye and accommodation, and thorough familiarity with the different tests advocated for the detection of anomalies of the ocular muscles, are what make the optometrist of today a strictly professional man.

II. DIRECT EFFECT OF EYESTRAIN ON THE ORGANS OF VISION.

A. Astigmia, Hyperopia and most of the types of heterophorias tend to increase the blood supply to the orbit.

B. Such a condition makes those who have either defective refraction or abnormal ocular adjustment liable to chronic inflammatory conditions of the:

1. Lids (stye, chalazion, blepharitis, ptosis and blepharospasm).

2. Conjunctiva (chronic conjunctivitis).

3. Episclera (conjunctiva of sclera, episcleritis and pterygium).

4. Cornea (keratitis and corneal ulcers).

C. Late in life excessive blood supply to the orbits as a chronic condition may help to induce organic changes in the structure in:

1. Crystalline lens (cataract).

2. Retina (a detachment of retina; retinitis; optic neuritis).

3. Choroid (choroiditis).

III. THE ADVENT OF EYESTRAIN.

The age at which it commences is very variable and depends on several factors.

A. The degree of Hyperopia, because it will appear sooner if the refractive error is higher.

B. It depends upon the actual amplitude of accommodation possessed by the individual.

C. It will be governed very largely by the condition of the balance between the horizontal muscles. It appears sooner if the condition is one of tendency to converge the visual lines, especially when they are at rest, and later if the tendency is to diverge.

D. It depends upon the temperament of the individual.

Thus: It may occur that two individuals have the same amount of Hyperopia, amplitude of accommodation and similar muscle balance; yet the one suffers from eyestrain at 20 years, while the other is not troubled until he is double that age.

CHAPTER XVI.

PIN HOLE DISC

I. DESCRIPTION.

A solid piece of metal or rubber, circular in form, and with a very fine hole in the center. The complete disc is made to fit the trial frame.

II. PURPOSE.

The purpose of this disc when placed in front of the eye is to reduce artificially the size of the pupil, cutting off the peripheral rays of light, thus allowing the rays of light entering thru it into the eye to make an image without focusing.

III. USES AND LIMITATIONS:

A. In general:

Vision poorer than normal must be due to:

1. Absence of a sharp retinal image.
2. Amblyopia.
3. Opacity.
4. Disease.

B. Pinhole disc is employed to distinguish as far as possible between these conditions. If the defective sight be due to ametropia, the disc will improve vision. Confining the light entering the eye to a very narrow pencil so that the circles of diffusion on the retina are correspondingly small, tends to improve vision; but at the same time the intensity of the illumination is so much reduced that the sight is rarely as good as that with correcting lenses in place, provided it be a regular error of refraction.

C. If the defective sight is due to amblyopia, opacities or disease, no reduction or improvement will

result, thus indicating that the case is not optical only.

D. The disc may improve sight, yet there may be disease, part of the reduction being due to the latter and part to the ametropia. In such cases no lens would make normal vision.

E. The disc may improve vision, yet it does not follow that lenses will subsequently improve it, as in cases of irregular astigmia and conical cornea.

F. The disc may fail to improve sight and yet there may be an optical defect, particularly in cases of partial amblyopia.

G. When vision is fairly good the pinhole is of little use. The reduction of light admitted into the eye would largely counteract any sharpening of the image.

H. When the pupil is small the effect of the pinhole is slight. If the pupil is of pinhole size, the disc is useless.

IV. VALUE.

The pinhole disc used with a knowledge of its limitations, is a valuable little instrument. It does not definitely determine or exclude disease, nor but it does distinguish between disease, opacities and amblyopia. It does tell that if it improves vision the eye is in all probability healthy, while if it fails to improve the sight, the eye is very probably not healthy and has something more than a purely optical defect. Therefore the use of the pinhole disc suggests the cause of an optical defect rather than gives conclusive evidence of the cause.

V. METHOD OF OPERATION.

When using the disc, one eye is occluded, and the pinhole disc is placed in front of the other,

taking care that the aperture is directly in the line of vision. Some patients find it difficult to see thru the pinhole, therefore, it is better to allow the patient to hold the disc in front of the eye to be tested, using the right hand for right eye and vice versa.

In many trial cases there are found two pinhole discs with different sized holes. If vision is much reduced the larger pinhole should be used.

VI. How can you use the pinhole disc to determine the character of refractive error and approximately estimate the amount? (Texas)

The patient holds the pinhole disc several inches in front of his eye, looking thru it at the test chart. He is told to move it slightly up and down or in and out. He reports that the distant test letters appear to move. If the movement is in the same direction, Myopia is indicated; if in the opposite direction, Hyperopia. The lens that will stop all movement will roughly represent the amount of the Ametropia.

Wisconsin Explain why the pinhole disc indicates whether vision will be improved?

The theory of the pinhole disc is that, apart from the distance between the principal focus and the retina the disc of confusion at the retina depends directly on the effective aperature of the refractive media, i.e. on the size of the pupil. The pinhole reduces the latter to a minimum with the consequent reduction in the size of the retinal confusion disc and improvement in sight.

CHAPTER XVII.

SCHEINER'S TEST

I. WHAT IS IT?

It consists of an opaque disc with two very small holes, separated by a distance from each other, of less than the diameter of the pupil of the eye under examination. The apertures are usually one millimeter in diameter and are separated by an interval of 1 mm.

II. USES.

A. To correct ametropia: { axial { hyperopia / myopia ; Curvature - Varieties of astigmia

A good test in theory, but not sufficiently accurate for practical purposes.

B. To find the Punctum Proximum:

Still a good test.

C. Method of operation.

1. For Ametropia:

Place the disc close to the eye so that light may pass thru both openings into the eye at the same time. Light from a small source at infinity enters the eye and forms two images which, if the eye is emmetropic, coincide at the retina, only one then, being seen.

When ametropia exists two images are seen. The correction is the strongest plus, or the weakest minus that, held in front of the disc, causes the two images to be seen as one.

2. For the Punctum Proximum:

Put the ametropic correction on. Hold a thin object at right angles to a line joining the pinholes, and parallel to the disc. It is then brought near to the eye until a point is

reached at which the accommodation fails to fuse the images and the object is seen double. The nearest point at which the object is seen singly, represents the distance of the P.P.

D. Objection.

1. General:

The difficulty in keeping the disc so adjusted that the pupil includes both openings.

2. Special:

In the test for ametropia the eye should be either totally presbyopic or under the influence of a cycloplegic.

CHAPTER XVIII.

AMBLYOPIA

I. In case one eye, or both, cannot be made to see the normal line, it indicates that the acuteness of vision is imperfect.

II. THE FAULT MAY BE IN:-

A. Media.
B. Retina.
C. Optic nerve.
D. Brain.

III. THE NAME OF THIS CONDITION IS AMBLYOPIA. Dull eye

IV. DEFINITION:

Dimness of vision not due to refractive error or active ocular diseases.

V. TABLE OF AMBLYOPIA:

- A. Primary:
  - 1. Congenital
    - a. Word blindness
    - b. Color blindness
  - 2. Acquired
    - a. Toxic
      - a. Amblyopia exanopsia.
      - b. (1) Nicotinica (tobacco)
      - (2) Potatorum (alcoholism)
      - (3) Quinine
      - (4) Choral: Iodoform: Lead: Arsenic
    - c. Traumatism
    - d. Hysterical
    - e. Post-marital (excessive sexual indulgence).

(continued)

B. Secondary
- 1. Nictalopia
- 2. Hemeralopia
- 3. Entoptic phenomena
  - a. Muscae volitantes
  - b. Micropsia
  - c. Macropsia
  - d. Metamorphosia
- 4. Hemianopsia
  - a. Homonymous
  - b. Heteronymous
    - (1) Binasal
    - (2) Bitemporal
  - c. Vertical
    - (1) Inferior
    - (2) Superior
- 5. Achromatopsia or color blindness or Daltonism
- 6. Anesthesia
- 7. Hyperesthesia

A. Primary (or true or original):

Definition: Amblyopia without any anomaly which may account for it.

1. Congenital: Born in the eye.

[Note: Congenital amblyopia affects only one eye usually, and is frequently associated with high amounts of hyperopia and hyperopic astigmia.]

a. Congenital word blindness:

It consists in an inability or difficulty in reading and spelling and is supposed to be due to a defect in the visual memory center for words and letters. If detected early in life much improvement can be effected by training. It is more common in boys than girls.

b. Congenital color blindness:

The cause is unknown but the color sense can be developed if training begins at a sufficiently early period in life. It is

more common in males than in females. Generally affects both eyes. The other functions of the eye are otherwise normal.

Usually it manifests itself as a partial achromatopsia, that is, a loss of perception for one or two fundamental colors. Total achromatopsia is very rare as a congenital defect, although it is not uncommon in secondary achromatopsia, occurring in optic nerve atrophy, in which case vision is markedly impaired.

2. Acquired.

Develops during life time:

a. Amblyopia exanopsia:

For want of use.

b. Toxic:

Amblyopia brought on by the poisonous effect of certain substances upon the nervous system.

(1) Nicotinica:

(Tobacco amblyopia) Smoking, chewing and occasionally after taking snuff. The practice of smoking when the stomach is empty is a predisposing cause.

(2) Potatorum: (alcoholic amblyopia)

[Note: Very often we find cases of toxic amblyopia. Nicotinica and potatorum together.]

(3) Quinine (use of much quinine).

(4) Chloral (use of much chloral).

(5) Iodoform (use of much iodoform).

(6) Lead (use of much lead).

(7) Arsenic (use of much arsenic).

c. Traumatic: injury
Caused by a blow on the eye without any change taking place in the structural parts of the eye itself.

d. Hysterical amblyopia:
Due to a nervous reflex.

e. Post-marital:
Due to excessive sexual relations.

B. Secondary Amblyopia. something abnormal
Definition: Amblyopia, but with an anomaly which may account for the same.

1. Nictalopia: (Gr. Nycto = night; alaos = obscure; ops = eye.)
Night blindness in which the sight is better by day than at night.

Exs. (A) Cortical cataract when the opacity is found at the borders of the crystalline lens.

(B) Pigmentary degeneration changes in the retinal elements.

[Note: The latter is a symptom of a certain form of secondary atrophy of the optic nerve, especially retinitis pigmentosa.] Syphilitic

2. Hemeralopia: (Gr. hemera = day; alaos = obscure; ops = eye.)
Day blindness in which sight is better at dusk than by day.

Exs. (A) Nuclear cataract: At night the pupil enlarges and the central opacity does not obstruct all the light.

(B) Central scotoma (blind spot on the retina). Surrounding retinal elements will receive better impressions during the evening hours.

[Note: The latter is very often found in toxic amblyopia.]

3. Entoptic phenomena:

a. Derivation:
Entos = within; ops = eye.

b. Definition:
Phenomena which are peculiar to the structures which are inside of the eyes.

c. The four most important entoptic phenomena:

(1) Muscae volitantes:

(a) Derivation:
Musca = fly; volare = to fly (or flying.)

(b) Definition:
Floating specks in the field of vision which manifest themselves as spots before the eyes.

(c) Cause:
Generally caused by shadows cast upon the retina by the cells normally found in the vitreous and are present in all eyes (more or less) under circumstances such as exposure to uniformly bright surfaces.

*

Note:

The important things about floating specks is to find out whether the specks seen by the patient are fixed or move about when steadily looked at. If they move they are of no special importance; if they remain constantly in the same line of vision, then it is quite probable that they represent some local ocular lesion which in turn may indicate some systemic disease.

(d) Occurrence:

Found more frequently in eyes that are not emmetropic, especially in myopic eyes. When muscae volitantes are present, the annoyance may be aggravated temporarily during digestive derangements. They look in the field of vision as grayish shadows which move with the changes in the position of the eyes, and have the shape of dots or globules and are frequently connected with strings. They are annoying and sometimes alarm the patient; but they do not affect the acuteness of vision.

* (e) Treatment:

Correction of the error of refraction, and relief of the disturbance in indigestion. They often persist, (especially in myopic eyes) until the patient at least ceases to look for them and thus forgets about their existence.

(2) Micropsia:

(a) Derivation:

Micros = small; ops = sight.

(b) Definition:

Seeing of objects smaller than they really are.

(c) Cause:

Due to paralysis of the ciliary body brought about by the contraction of the retinal elements caused by inflammation. It is, therefore, the result of a displacement of the retinal elements over the inflamed focus.

(3) Macropsia:

(a) Derivation:
Macros = large; ops = sight.

(b) Definition:
A disturbance of vision in which the objects seem larger than they really are.

(c) Cause:
It is due to a disturbed relationship of the rods and cones after an inflammation of the retina has subsided. It is developed by the adhesive bands of lymph which put both the rods and cones upon a stretch.

(4) Metamorphosia:

(a) Derivation:
Metamorphos = to change shape; ops = sight.

(b) Definition:
A disturbance of vision in which the objects seem distorted; straight lines appearing bulged and wavy.

(c) Cause:
Changes in the retinal elements caused by old inflammation of the retina.

[Note: Micropsia, macropsia and metamorphosia are specific symptoms of exudative or non-suppurative choroiditis and suppurative choroiditis.]

4. Hemianopsia.

a. Derivation:
Hemi = half; an = no; opia = sight.

b. Definition:
Blindness in one half of the ~~retinal~~ visual field.

c. Cause:
Gummata (gummy tumor) characterizing the tertiary (third) stage of syphilis. Consists of granular tissue.

[Note: The gummata are located in the optic chiasm, and the fibres of the optic nerve affected, locate the hemianopsia.]

d. Varieties:

(1) Homonymous:
On the nasal side of one eye and the temporal side of the other.

(2) Heteronymous:

(a) Binasal:
At the nasal side of both eyes.

(b) Bitemporal:
At the temporal side of both eyes.

(3) Vertical:

(a) Inferior.

(b) Superior.

5. Achromatopsia:
Color blindness or Daltonism.

6. Anesthesia:

When applied to the eye, is a lack of sensibility of the retina to visual impressions. (Gr. An = not; aisthesis = sensation).

7. Hyperesthesia:

When applied to the eye, is excessive sensibility of the retina to visual impressions. (Gr. hyper = over; aisthesis = sensation).

CHAPTER XIX.

ASTHENOPIA

I. MEANING:

Gr. A = without; stenos = strength; opia = eye.

II. DEFINITION:

Weakness of the ocular muscles or visual power producing uncomfortable, irritable and even painful sight.

III. SYMPTOMS:

A. Common:

1. Pain due to the continuous strain placed upon the weakened muscles in obtaining and maintaining equilibrium.

2. Blurring in consequence of the inability to maintain an even balance between the two eyes.

3. Ocular headaches (frontal and occipital) due to a strain upon the nervous system by the loss of nervous force required to keep up the extra effort necessary to maintain equilibrium.

4. Redness or inflammation of the lids and conjunctiva.

5. Lachrymation.

6. Photophobia.

B. Special:

1. Nausea.
2. Vertigo.
3. Insomnia.

4. Mental depression.
5. Nervous prostration.
6. Chorea. St Vitis Dance
7. Epilepsy.

IV. TABLE:

Asthenopia
- Accommodative.
- Muscular.
- Nervous
  - Reflex
  - Retinal

Most important

- Anisometropic.
- Astigmatic.
- Presbyopic.
- Hyperphoric.
- Cyclophoric.

V. DEFINITIONS AND EXPLANATION:

A. Accommodative:

It results from over-use of the ciliary muscle and since this muscle has the greater tax thrown upon it in hyperopia or a hyperopic state of refraction, this kind of asthenopia is pre-eminently the asthenopia of hyperopic eyes.

B. Muscular:

It results from muscular imbalance which necessitates an abnormal strain to procure and maintain single binocular vision.

C. Nervous:

It is due to various nervous disturbances such as hysteria, functional disorders, poor health in general, dental decay, overuse of the eyes, faulty iritic action (sphincter and dilator), bad lighting, unsanitary surroundings, poor and insufficient food and want of exercise.

1. Reflex:

When the exciting cause is remote from

the eye.

2. Retinal:

Is due to actual fatigue or exhaustion of the nervous elements of the retina and in this case there may be quite an alarming reduction of vision.

VI Characteristically Asthenopic looking eye.

1. Redish
2. Watery
3. Weak
4. Do not always suffer from pain yet they need glasses just as much as those which are painful.

CHAPTER XX.

DIPLOPIA

I. DERIVATION:

Greek. Diplos - double. Ops - vision.

II. DEFINITION:

In general, double vision. Seeing one object as two. Resulting when the image of an object does not fall on corresponding parts of the retina of each eye.

III. KINDS.

Table
- Binocular
  - Homonymous, or direct, or uncrossed.
  - Heteronymous, or crossed.
- Monocular or Uniocular.
- Physiological.

[Notes: 1. Monocular Diplopia: is diplopia with a single eye, usually due to:-
a. Hysteria.
b. Double pupil.
c. Beginning of cataract.
d. Displacement of the Crystalline Lens.
e) Traumatic

2. Physiological Diplopia:
The doubling of an object nearer or farther than the point fixed.

Physiological Diplopia is proven by the fact that when the eyes are fixed upon a distant object, a pencil held at arms-length in the line of vision appears as two.]

CHAPTER XXI.

PURKINJE'S FINDINGS

I. PURKINJE'S IMAGES (entoptic phenomena.)

They are projected images of the retinal vessels on the receptive layer and are a picture of the observer's retinal blood vessels on an apparently dark background.

When, in a dark room, a lighted candle is waved about, close to and just below the line of vision, these images are produced.

II. CATOPTRIC TEST OR PURKINJE'S TEST OR SANSON'S TEST.

A. Equipment and method of procedure.

1. Dark room.

2. Lighted candle 45 degrees to one side (of patient's eye).

3. Observer 45 degrees to opposite side.

4. Observed eye (patient's) looking at infinity.

5. Three images appear to be on the cornea.

a. A bright virtual image, upright, reflected from the outer surface of cornea acting as a convex mirror.

b. Behind the first, a second upright image from the front surface of crystalline lens, acting as convex mirror. It is larger, very much more diffused and difficult to see.

c. A very small real inverted image, reflected from the back surface of crystalline lens, acting as a concave mirror.

6. When the observed eye accommodates, the second image becomes smaller, clearer, and advances sideways toward the center of pupil, proving that the front surface of crystalline lens has become more convex.

Images a and c do not change.

B. What does this prove?

That the anterior surface of crystalline lens is more affected by the act of accommodation.

III. PURKINJE'S EXPERIMENT.

Purkinje in experimenting with feeble illumination discovered that vision for the shortest waves was more persistent than that for the longest. If two parts of the spectrum be taken, say, red and blue, and rendered equally intense, the red will appear to most people to be the brighter, but as the illumination is reduced, the red fades more rapidly than the blue, so that when the red has altogether disappeared, the blue is still visible as pale gray.

X

CHAPTER XXII.

THE CHROMO-ABERRATION TEST, OR COBALT BLUE TEST, OR CHROMATIC TEST

I. DESCRIPTION OF THE DISC.

The disc used in this test consists of a very thick cobalt blue glass. To the eye, cobalt blue glass appears dark but it contains a great deal of red.

II. OPTICAL PROPERTY:

This disc blocks out the central colors of the spectrum and the power of the cobalt blue glass to exclude all but blue and red rays gives this test its principle. The separation of the colors is due to the fact that blue rays, being more refrangible than red, come to a focus sooner than the red, and in consequence red rays will focus back of the blue.

III. USE AND METHOD OF OPERATION:

A. The chromatic test takes its name from the fact that it is based on the chromatism of the eye and can be used for the approximate determination and correction of refractive errors.

B. Dark Room.

C. Small round area about 1 inch in diameter of steady white light located at 6 meters.

D. Each eye is to be tested separately.

E. The appearance of the light indicates the kind of ametropia or tells that the eye is emmetropic.

IV. HOW THE LIGHT MAY APPEAR.

A. In emmetropia: as a purple circle with a light blue margin.

B. In Hyperopia: blue circle with a light red margin.

C. In Myopia: red circle with a light blue margin.

D. In Simple Hyperopic Astigmia: purple ellipse with red extremities.

E. In Simple Myopic Astigmia: purple ellipse with blue extremities.

F. Compound Hyperopic Astigmia: blue ellipse with red extremities.

G. Compound Myopic Astigmia: red ellipse with blue extremities.

H. Mixed Astigmia: A circle or ellipse, purple in center with extremities red in one direction and blue in the other.

I. Irregular Astigmia: Irregular oval or ellipse.

V. IMPORTANCE OF TEST:

The test is not sufficiently delicate to be of any practical utility and generally the eye appears to possess a greater static refraction than is actually the case. In other words, the Myopic eye is apparently more Myopic and the Hyperopic eye less hyperopic.

VI. CORRECTION.

Theoretically, the lens or combination of lenses that causes the source of light to be seen as a circular purple disc with light blue margin, as in emmetropia, is the correction of error.

CHAPTER XXIII.

COLOR VISION

THEORIES OF COLOR VISION - AFTER IMAGES - OPTOGRAMS - PHOSPHENE.

I. Primitive man could see but not distinguish colors. Everything appeared gray to him. The eyes had no color perceiving vision. The nerve terminals of the nerve fibers are called Rods.

II. Stimulating a rod causes a sensation of light.

III. As time went on some of the rods changed into cones and cones stand for color. The cones are nothing more than rods split into three parts.

IV. THEORIES OF COLOR VISION.

A. Young & Helmholtz Theory (or "Three component theory.")

The fibers into which the rods are split are not alike. One is stimulated chiefly by red light, another by green light and the third by blue or violet light. In the brain we have connections corresponding to each one of the fibers. By blending the sensations we get to see the different tints or shades. Absence of one of these perceiving substances produces color blindness.

The Young - Helmholtz theory finds its basis in the physical phenomenon of three wave lengths of light capable, when mixed in various proportions, of exciting the sensation of white and of all the thousands of colors we can perceive. This theory, therefore, may be appropriately called the physical theory of color vision.

B. Hering's Theory (or Opponent Color theory).

Each one of the sections of the rod is susceptible to two kinds of stimuli: one black and

white; one red and green; and one yellow and blue. There are only four perceiving elements on the retina: red, green, yellow and blue. These color perceiving elements are subject to positive (producing colors) and negative (producing the compliment) changes.

Hering's Theory is based on the fact that in the spectrum are four primary colors (red, yellow, green & blue) which are psychologically elementary, in that no one of them carries with it any suggestion of the other three. Therefore, his theory was called the psychological theory of color vision. It is a complicated theory, but cannot be accepted because we do not believe it possible for two kinds of energy to go over one nerve fiber.

C. ELDRIDGE - GREEN THEORY.

According to this theory a photograph is formed on the retina by the decomposition of the visual purple in the rods. This chemically stimulates the ends of the cones causing a visual impulse to be transmitted thru the optic nerve fibers to the brain. It assumes that the impulse differs in quality according to the wave length (color) of the rays of light producing the color and that there is a special center in the brain to distinguish these differences.

D. LADD - FRANKLIN THEORY. (Evolution Color Theory, or Genetic Theory.)

This theory holds that the color mechanism has been evolved from a comparative simple structure, a certain kind of gray molecule, which, on being stimulated by light, sets free a chemical compound capable of stimulating the retinal nerves. The original mechanism responds to all ether vibrations in one way, so that all objects seen were of varying intensities of gray (monochromatic vision). A vestige of this primitive mechanism is yet found in the peripheral portion of our retina (achromatic vision). According to this theory, in the

course of evolution, this simple gray substance gave rise to two components; yellow & blue, which are decomposed by long and short wave lengths respectively. (This is the tetrachromatic vision in which we have the four primary color sensations of red, yellow, green and blue). These two compounds are in a central zone which is still smaller than the yellow - blue field.

This theory genetically explains the three retinal zones; the achromatic, the dichromatic and tetrachromatic zones.

V. AFTER IMAGES.

The altered action of the retina under fatigue, due to over-stimulation, produces after images which may be positive or negative. Positive, when the eye sees the same color and negative when it sees its complement.

VI. OPTOGRAM.

A faint image stamped on the retina for a brief period after death, believed to be that of the last object seen before death. When this image is fixed with a 4% solution of alum in the dark a natural print called an Optogram is obtained.

VII. PHOSPHENE.

It is a subjective luminous sensation caused by pressure on the eyeball. If the eye be closed, turned inward as much as possible, and then gently pressed with a pencil at a point near the outer canthus, a luminous impression, called phosphene, is produced.

VIII. EFFECT OF COLORS ON THE NERVOUS SYSTEM.

A. Injurious colors.

1. Red - excitement.
2. Violet - sadness.
3. Green - extreme mental depression.

B. Healthful Colors.

1. Olive green and tans are the most soothing.
2. Shades of blue, pale yellow and brown come next.

IX. TERMINOLOGY OF COLOR VISION. (Technical names.)

A. Erythropsia. (Red vision)

B. Cyanopsia. (Blue vision)

C. Xanthopsia. (Yellow vision)

D. Chloropsia. (Green vision)

E. Purple Vision.

CHAPTER XXIV.

COLOR BLINDNESS AND TESTS FOR COLOR BLINDNESS

I. INTRODUCTORY STATEMENTS.

A. A color is characterized by three qualities:

1. Hue, also known as tone or pitch, which is determined by the frequency of the ether vibrations.

2. Luminosity, (intensity), which depends on the amount of light of a given wave length, falling upon a unit area of the retina, in a given length of time.

3. Saturation, which expresses the purity of the color.

B. In the spectrum; red, green and blue are known as fundamental or primary colors.

C. Normal color vision is known as trichromatic vision because all three color wave lengths must be employed in order to produce all possible color sensations.

II. DEFINITION OF COLOR BLINDNESS.

A. All the theories put forward to explain the facts of color vision regard color blindness, whether total or partial, as an affection or lack of normal development of the cones resulting in a faulty decomposition of the three photo-chemical substances present in the retina.

B. Color blindness of all sorts is a defect caused by the lack of some part of the neural machinery necessary for normal color vision.

III. CLASSIFICATIONS OF COLOR BLINDNESS.

A. In classifying the various normal and abnormal color visions, it should be understood that all gradations exist from the most highly developed trichromatopia to the totally color blind.

B. First Classification:

- Color-Blindness --
  - Monochromatopia or Achromatopia
  - Dichromatopia--
    - Protanopia or red-blindness.
    - Deuteranopia or green-blindness.
    - Tritanopia or blue-blindness.

C. Explanations.

1. The monochromat sees only one color, namely the untoned or gray; hence, it may be well to designate this vision as achromatopia.

2. For a dichromat all the color sensations can be produced by the mixing of two fundamental color wave lengths.

3. As dichromatopia is far more common than achromatopia, and as tritanopia is very rare, the term color-blindness as commonly used, has reference to either protanopia or deuteranopia.

4. Frequently we see the term red-green blindness, as this is one simple defect best described by the inability to discriminate between red and green.

D. Second classification.

Color Blindness -- {Congenital. Acquired. Temporary. Artificial.

E. Explanations.

1. Congenital:
Present at birth and sometimes hereditary.

2. Acquired:
Jaundice; certain drugs as santorun and male-fern; excessive use of tobacco produces color blindness for red and green around the macula area only, a characteristic of nicotine poisoning.

3. Temporary:
Excessive stimulation of the retina by any one color of excessive brightness as found when after images are seen.

4. Artificial:
Colored glass or chromatic light.

IV. TESTS FOR COLOR BLINDNESS.

A. The Holmgren or Wool Test.

1. Equipment.

a. Three large test skeins: green, rose and red.

b. More than a hundred small skeins consisting of red, orange, yellow, yellow-green, pure green, blue-green, blue, violet, purple, pink, brown and gray with several shades and tints of each color. These may be called "confusion colors."

2. Method of Procedure.

a. First Stage.

(1) The confusion wools are mixed, the green test skein is given to the subject and he is told to pick out all the skeins that resemble this in tone.

(2) A person having normal color vision selects the lighter and the darker greens only.

(3) The color-blind add to greens some pale shades of grays, brown and yellow.

b. Second Stage.

(1) The confusion wools being again mixed the rose (a mixture of red and blue) test skein is presented and the subject is asked to match it from the heap.

(2) A person having normal color vision will make no mistakes.

(3) The red-blind, not recognizing the red in it, match this rose with blues and violets.

(4) The green-blind match this rose with greens and grays with or without purple (rose is reddish purple).

c. Third Stage.

(1) The red test skein is presented for matching.

(2) The red-blind selects red, greens and browns of the darker shades than the test skeins.

(3) The green-blind selects reds, greens and browns of a lighter shade than the test skein.

B. The Jennings Self-Recording Test.

It consists of a square box, divided into two compartments; one for the green test and the other for the rose test. The standard test skeins of green and rose, respectively, are attached to the inside of the box lid. On each side of the box is a color board made up of green and all the green-confusion colors on one side, and of rose and all the rose-confusion colors on the other side. In the center of each color patch is a perforated hole, thru which the patient thrusts a stylus to register his selection of a match-color. Beneath the color board is a record sheet, divided into squares corresponding to the color-patches and marked with a G and an R, respectively, in those squares which coincide with a color-patch which matches the green or the rose.

If the patient be normal, there will be a punch marked on the record sheet in every space marked G and R. Any punch mark in a blank space indicates a mistake. If the mistakes are on a horizontal line with the letter G, the mistake was made in the green test; if horizontal with the letter R, in the rose test.

C. Williams' Lantern Test.

It consists of many lanterns, screened by shutters, which are lighted in a dark room with the colored glasses made to face the patient directly. By means of a revolving shutter the colored lights are revealed to him, usually two or three at a time and he is required to call out the names of the colors.

D. Nagel's Test.

It consists of a set of cards each bearing a series of little colored discs arranged in a

ring. In some rings the discs are all of the same color, but in different shades. In others there are two or three different colors. By asking the patient to indicate which are monochromatic, which dichromatic and which trichromatic, we readily ascertain the existence and nature of his color-blindness.

E. Edridge-Green Lantern Test.

It consists of a system of lanterns similar to that of Williams'. The colors yellow, pure green, signal green, blue, purple and red are mounted on three discs; a fourth is ground glass with white light. The discs are rotated and brought before the lamp in succession and any desired combination formed. A diaphragm imitates the representation of railway signals.

F. Ishihara's Test.

It consists of a large number of dots of various colors which are printed in such a manner as to form no particular design for a trichromatic person, but in which the red blind, or green blind, recognize a certain letter. Other cards are printed in colors that reveal letters to normal, but not to the color blind.

G. Hess Objective Test.

It is based on the fact that the degree of constriction of the pupil depends upon the brightness of light. By means of his "pupilloscope," Hess was able to show that the pupil of a color-blind does not behave towards the various wave-lengths as that of a trichromat.

H. Terminology.

1. Achromatopsia - total color blindness.
2. Anerythropsia - red blindness.
3. Achloropsia - green blindness.
4. Acyanopsia - blue blindness.

Colored glasses are required and may be ordered to:

1. Protect diseased portion of eye from action of light as in retinitis conjunctivitis, etc.

2. To relieve photophobia accompaning a disease as in iritis

3. To prevent action of light natural or artificial on the crystaline lens likely to cause cataract in the typic or in special occupations.

4. To cause dilation of the pupil in incomplete nerolar cataract.

5. For cases of true photophobia and hyperesthesia of retina

6. For conditions such as aniridia, albinism, hemeralopia and nyctalopia, coloboma, iridectomy

7. Cataract (A glass which cuts out actinic rays)

8. Amblyopia (Amber is recommended for some cases).

9. Neurasthenia (light colored glass or placebo)

CHAPTER XXV.

COLORED AND TINTED LENSES

(The special sign * indicates the most prominent colored lenses).

I. GREEN (England 1561)

The oldest colored glass used for optical purposes. Restful to the eyes. Green which prevails in nature fatigues the eye least of all colors. For this reason billiard tables are covered with green cloth and blinds are usually painted green.

*II. BLUE (England 1672)

The sea and sky are blue and the eye is able to bear those colors best which are most widely distributed in nature. At one time blue glasses were quite popular for seashore glasses and to reduce the glare and heat from furnaces but now are rarely used.

A. Shade A absorbs 40% red but gradually loses value completely across the spectrum to violet where its entire value of absorption is lost.

B. Shade B absorbs 60% red gradually losing value to violet which is absorbed 5%.

C. Shade C absorbs 50% red, 65% yellow, and then gradually loses value until violet is reached which is absorbed 10%.

D. Shade D absorbs 20% red, 35% yellow, 80% green, 50% blue, while violet reaches its highest rate of absorption, being 20%.

*III. SMOKE (England 1767)

A glass of gray or neutral color. Smoke glasses in the various shades absorb almost equally (except C shade) all the components of white

light and when in front of the eye reduce the visual acuity to a greater or lesser degree. They do not change the color of a body unless it is of deep tint when it causes all dark colors to appear black and light ones grey.

A. "A" shade with absorbing value of an average of 10% from red to blue and has a tendency to lose value with violet.

B. "B" shade with absorbing value of an average of 20% thru the entire spectrum.

C. "C" shade with absorbing value of 50% for red, yellow, green and blue with 70% at violet and ultra-violet.

D. "D" shade acts evenly completely across the spectrum at an average of 80%.

[Note: Sun glass is a dense smoke glass used in eyepieces of telescopes.]

*IV. AMBER (England 1832)

An orange colored glass made in 6 or 8 shades of which the most important are:

A. "A" shade which absorbs 20% red, yellow and green; 40% blue; and 50% violet.

B. "B" shade which absorbs 20% red, yellow and green; 50% blue; and 70% violet.

*V. FIEUZAL (Invented by German scientist; but glass made in France 1880)

A yellowish green glass.

A. "A" shade absorbs 20% red; 10% yellow, green and blue; 30% violet and ultra-violet.

B. "B" shade absorbs 40% red; 10% yellow and green;

40% blue; 60% violet.

*VI. AMETHYST (Philadelphia 1885)

It has a violet color, a combination of red and blue glass.

A. "A" shade absorbs 20% from red to violet but loses its value with violet which is absorbed only 10%.

B. "B" shade absorbs 30% red and yellow; 50% green; 30% blue and violet.

VII. EUPHOS (Germany 1907)

The color is similar to the Fieuzal but better as to properties because the glass cuts down more of the violet rays but does not cut down the illumination to such a large extent as Fieuzal.

A. "A" shade is best to be used for water, automobile and air sports.

B. "B" shade is best to be used as snow spectacles or for excursions in high altitudes.

C. "C" shade is best to be used for those who work constantly in intense light.

*VIII. NOVIOL (Chicago 1914)

A yellowish glass made in 3 shades:

A. "A" shade absorbs not more than 5% from red to violet but absorbs 90% violet and practically all the ultra-violet.

B. "B" shade absorbs not more than 10% of all colors to violet; 90% violet and ultra-violet entirely.

C. "C" shade absorbs 10% red, yellow and green; 70% blue; and violet and ultra-violet are entirely absorbed.

*IX. CROOKES (England 1915)

These took the name of tinted glasses because the glass is so lightly colored that the tint is almost imperceptible.

A. "A" shade (very light greenish yellow tint recommended for general use) absorbs 10% red; 50% yellow; 40% green; 20% blue and violet.

B. "B_1" shade (light lemon yellow recommended for motorists, shooters, engineers and firemen) absorbs 30% red; 70% yellow; 60% green; 45% blue and violet.

C. "B_2" shades (more nearly a true yellow, recommended for use whenever the wearer needs greater protection from extremely brilliant light or reflection as in the case of mountain climbing, ocean travel and tropical wear). It absorbs all the ultra-violet, all the violet and practically all the blue rays.

X. SOFT LIGHT (SOFT LITE) LENSES (Bausch & Lomb Optical Co.)

Of all tinted lenses Soft lights most nearly approach the natural flesh color. They will not cast shadow about the eyes nor be otherwise conspicuous in use.

They filter the light sensibly in a natural way: absorb all the harmful light and transmit all beneficial rays. Made in 3 shades that meet all requirements: light, dark and sport. Punktals, Kryptoks Voltex and C.V. lenses can be had in Soft-Lite tints.

XI. WELLSWORTH CRUXITE.

They absorb ultra-violet and transmit only slightly less of the visible spectrum than white glass. A very slight absorption is caused by the pinkish tint.

CHAPTER XXVI.

SPECIAL FACULTIES WHICH ENABLE US TO UTILIZE THE RETINAL IMAGE

I. COLOR SENSE.

The faculty of the eye in distinguishing light of different wave lengths.

II. LIGHT SENSE.

The faculty of the eye in distinguishing illumination and its graduations.

[Notes: 1. The distinction between light and darkness is the lowest degree of this faculty.
2. The lowest limit of light that can be observed by an eye is termed its light threshold and varies in different people.]

III. FORM SENSE.

It is the faculty of the eye in recognizing outlines and shapes.

[Notes: 1. Estimation of form, solidity and size depend almost entirely on central vision, since the peripheral portion of the retina is comparatively insensitive to form.
2. The principal assistance in estimation of solidity is derived by the slightly different view of a solid body presented by the two eyes. In other words, the stereoscopic effect.]

[Important Statement.

The sense of SIGHT may be divided into the three above mentioned classes of perception: LIGHT, FORM & COLOR.]

IV. PROJECTION SENSE.

Definition: The power of locating a source of light

in space on a straight line which begins at the retinal image, passes thru the nodal point and continues for the total distance that the light has traveled in its course to the eye.

V. FUSION SENSE.

It is the faculty which the eye possesses of uniting the two ocular images into a single mental impression.

VI. ORIENTATION.

A. General Definition:

It is the power of ascribing to objects seen in space, the place where they are actually located.

B. Objective Orientation:

It refers to the comprehension of the position of objects with reference to each other.

C. Subjective Orientation:

It refers to the comprehension of the position of objects not only with reference to each other, but to ourselves as well.

[Note: Objective and Subjective Orientation are essential to the appreciation of the absolute position which any object occupies in space.]

CHAPTER XXVII.

TABLE OF THE CLASSIFICATIONS OF THE SUBDIVISIONS OF HYPEROPIA

Kind of H	Definitions: & of N	Symbol	May be:	Uncorrected Vision	Corrected Vision	Measured by:
Manifest	That part of H. which is apparent and is measured by the strongest plus lens accepted before fogging without reducing visual acuity.	Hm	Facultative	Normal by accommodation	Normal	Strongest convex lens giving best vision.
			Absolute	Defective	Normal or Defective	
Latent	H. concealed by ciliary spasm: may be made manifest by relaxing the ciliary by fogging lenses.	Hl	Facultative	Normal by accommodation	Normal but generally uncomfortable	Difference between strongest lens accepted before and after fogging.
			Relative	Defective	Normal or Defective	
Facultative	H. which may be overcome by accommodation	Hf	Manifest	See Hm.	See Hm.	Difference between Ha & Ht.
			Latent	See Hl.	See Hl.	
Absolute	H. that cannot be overcome by accommodation	Ha	Manifest only.	Defective	Normal or Defective	Convex lens giving best vision.

(Continued)

Subdivisions of Hyperopia (continued)

Kind of H	Definitions: C of N	Symbol	May be:	Uncorrected Vision	Corrected Vision	Measured by:
Total	The sum of H. manifest plus latent; or facultative plus absolute.	Ht	All 1-f.	See Hl.	See Hl.2	Strongest convex lens giving best vision after fogging.
			All m-a.	See Ha.	See Ha.	
			All m-f.	See Hm.	See Hm.	
			Part m & part 1	Normal or defective	See Hl.	
			Part 1 & part a.	Defective	See Ha.	
Relative	H. overcome by sacrificing binocular vision and squinting inward thus stimulating accommodation.	Hr	Part a & Part f	Defective	Defective or Normal	See Ht.

Note: Relative H is absolute H which becomes facultative by squinting.

CHAPTER XXVIII.

THE EFFECT OF MOTION PICTURES ON THE EYES

I. INTRODUCTORY.

A few years ago (1922) a public official in addressing a national welfare organization made the following startling prophecy:

"Motion pictures will be extinct in ten years. The public realization that they are ruining eyesight will lead to a demand that they be abolished."

The wonderful changes in the production of motion pictures and in their showing in recent years proved the fallacy of that prophecy because today there is no just cause for serious apprehension as to moving pictures harming the eyes providing attention is given to certain conditions.

II. WHAT IS THE MAJOR CAUSE FOR THE COMPLAINT THAT THE MOVIES HURT THE EYES?

If the viewing of moving pictures results in eye discomfort, headaches or drowsiness, the chances are that it is the eyes of the observer that are at fault rather than the moving pictures themselves. Movies do not cause eye trouble but frequently they do reveal the existence of eye defects.

Viewing moving pictures is distance vision and the eye is being subjected to no greater burden than viewing distant objects under ordinary conditions with this difference, of course, that there is the effort of constant and prolonged concentration in viewing motion pictures which does not exist with the use of the eyes ordinarily in observing distance objects. It is this element of concentration which causes motion pictures to act as a test of distance eye endurance and serves in many instances to indicate the presence of ocular defects.

If the eyes of the observer are normal for distance vision or corrected for refractive errors he should not experience discomfort in viewing motion

pictures provided certain other conditions prevail.

III. MECHANICAL FACTORS HAVING TO DO WITH THE EFFECT OF MOTION PICTURES ON THE EYE.

A. The film.

It must not produce streaks and spots of light or induce other objectionable defects.

B. The projection of the film.

Proper projection is an important factor in the elimination of eyestrain and eye discomfort.

Flicker will result in eyestrain even for a normal eye as flicker affects the involuntary muscles which control the action of the iris regulating the size of the pupil and the effort of the iris to rapidly contract and dilate the pupil in response to the stimulus of the rapidly varying light produced by the flicker will quickly produce a condition of extreme fatigue. The machine must be firmly mounted so that there will be no vibrations to affect the smoothness of the reflection from the screen. Any unsteadiness or jerkiness will produce eyestrain as a result of the abnormal burden placed upon the extrinsic muscles of the eye in their effort to keep the eyes in alignment with uncertain and erratic movements.

C. The Screem from which the Film is reflected.

Under no circumstances should an operator ever permit the light from the projecting apparatus to strike the bare screen. The sudden transition from the comparative low illumination reflected from the screen as a result of light passing thru the film to the relative excessively bright light would be blinding in effect and decidedly harmful to the eyes of the spectators.

Eyestrain will be produced if the picture on the screen is out of focus. Involuntarily the eye will try to compensate to make the picture more distinct.

In respect to the relative position of the screen and seats, certain conditions are important. The observer should be at least 20 ft. from the screen; for any distance less than 20 ft. will bring into use the accommodation and convergence of the eyes imposing the conditions of near vision. The angle of elevation in respect to the direct line of vision is important. The seats should be so placed that to observe the top of the picture the eyes need not be raised more than 35° from the direct horizontal line of vision.

At the far edge of the screen the angle formed by the screen and the line of vision should not be less than 25°.

D. General Conditions in the Auditorium.

The outstanding need here is for attention to the general illumination of the room while the picture is being shown. Most theaters are darkened more than they need be, with the result that a condition of undesirable contrast is created. The human eye does not function to its best advantage in the dark or in looking at a fairly well illuminated object when the eye itself is surrounded by darkness.

Too low illumination causes dilation of the pupil to an abnormal degree and provides a corneal area which does not permit of focal accuracy and which tends to distortion of outlines. Partially to overcome this, segmental action of the ciliary muscle governing the focusing of the eye is induced. Such muscular action can be attained only by great effort.

There is also strain of the iris muscles resulting from the prolonged dilation of the pupil and the varying intensity of the light reflected from the screen requires constant iris action which is more difficult to accomplish than under normal dilation.

The illumination of the auditorium should be gradually reduced from the rear to the front,

and all light sources so modified to prevent glare, especially those which may fall within the spectator's range of vision.

In the subject of general conditions pertaining to the auditorium must be mentioned one cause of headaches, no doubt frequently attributed to the eyes but which in no way has to do with light effects or eye defects. Lack of proper ventilation will quickly produce discomfort, dullness, headaches and other symptoms similar to those resulting from eyestrain.